

A revision of *Pelecitus* Railliet & Henry, 1910 (Filarioidea, Dirofilarinae) and evidence for the "capture" by mammals of filarioids from birds

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Abstract. — A study has been made of the filarioid genus *Pelecitus*, species of which occupy sites associated with the limb joints of birds and mammals and which in some hosts are known to provoke chronic inflammation. The diagnosis of *Pelecitus* is emended and examination of specimens has enabled redescrptions of the following species : *P. helcinus* (Molin, 1860) (type species), *P. circularis* (Molin, 1860), *P. tercostatus* (Molin, 1860), *P. fulicaeatrae* (Diesing, 1861), *P. anhingae* Vuylsteke, 1957, *P. polamaetus* Vuylsteke, 1957, *P. galli* Dissanaïke & Fernando, 1974, *P. tubercauda* Vanderburgh, Anderson & Stock, 1984, and *P. vuylstekae* nom. nov. (= *P. ardeae* sensu Vuylsteke, 1957). In agreement with previous authors, *P. calamiformis* (Schneider, 1866) is considered a junior synonym of *P. tercostatus*, and *P. podicipitis* (Yamaguti, 1935) a junior synonym of *P. fulicaeatrae*. *Pelecitus armenica* Chertkova, 1945, *P. ceylonensis* Dissanaïke, 1967, and *P. barusi* Coy Otero, 1982, are considered valid but specimens were not available for examination. Two new species are described, *P. andersoni* n. sp. from a "macaw" imported into the United States from South America, and *P. chabaudi* n. sp. from *Pernis apivorus* (L.) in Switzerland. *Pelecitus falconis* (Rudolphi, 1819), *P. serpentulus* (Diesing, 1851), *P. quadripapillosus* (Molin, 1860) and *P. ardeae* (Molin, 1860) n. comb. remain or are designated herein as *species inquirendae*. *Pelecitus alatus* Walton, 1927, is regarded as a *species incertae sedis*. Two species of Dirofilarinae from mammals are transferred to *Pelecitus*, i.e. *P. scapiceps* (Leidy, 1886) n. comb. and *P. roemeri* (Linstow, 1905) n. comb., and it is suggested that they are "captures" (sensu CHABAUD, 1965) from species in birds. It is possible that other examples of "capture" by mammals, of filarioids from birds, may exist. For example, *Rumenfilaria andersoni* Lankester and Snider, 1982 of *Alces alces* resembles species in the avian filarioid genus *Chandlerella*. *Pelecitus* species may be of zoonotic importance in South America; the "*Loaina* sp." resembling *P. scapiceps* reported by BOTERO *et al.* (1984) may have been a species of *Pelecitus* from birds. A key to species of *Pelecitus* is given and the host and geographic distributions of the species in birds are summarized.

Résumé. — Révision du genre *Pelecitus* Railliet & Henry, 1910 (Filarioidea, Dirofilarinae) et mise en évidence de « captures » de Filaires d'Oiseaux par les Mammifères. — Les auteurs ont étudié le genre *Pelecitus* dont les espèces, parasites d'oiseaux et de mammifères, sont situées au niveau des articulations des membres et sont connues pour provoquer des inflammations chroniques chez certains hôtes. La diagnose de *Pelecitus* est amendée et les espèces suivantes sont redécrites : *P. helcinus* (Molin, 1860) (espèce-type), *P. circularis* (Molin, 1860), *P. tercostatus* (Molin, 1860), *P. fulicaeatrae* (Diesing, 1861), *P. anhingae* Vuylsteke, 1957, *P. galli* Dissanaïke & Fernando, 1974, *P. tubercauda* Vanderburgh, Anderson & Stock, 1984, et *P. vuylstekae* nom. nov. (= *P. ardeae* sensu Vuylsteke, 1957). En accord avec les auteurs ayant précédemment étudié le genre, *P. calamiformis* (Schneider, 1866) et *P. podicipitis* (Yamaguti, 1935) sont considérés comme des synonymes mineurs de *P. tercostatus* et *P. fulicaeatrae*, respectivement. *Pelecitus armenica* Chertkova, 1945, *P. ceylonensis* Dissanaïke, 1967, et *P. barusi* Coy Otero, 1982, n'ont pu être observés mais sont considérés comme des

espèces valides. Deux nouvelles espèces, *P. andersoni* et *P. chabaudi*, sont décrites ; *P. andersoni* n. sp. provient d'un « ara » importé d'Amérique du Sud aux États-Unis, et *P. chabaudi* n. sp. d'un *Peris apivorus* (L.) originaire de Suisse. *Pelecitus falconis* (Rudolphi, 1819), *P. serpentulus* (Diesing, 1851), *P. quadripapillosus* (Molin, 1860) et *P. ardeae* (Molin, 1860) n. comb. sont confirmés ou désignés comme *species inquirendae*. *Pelecitus alatus* Walton, 1927, est considéré comme *species incertae sedis*. Deux espèces de Dirofiliariinae de mammifères, *P. scapiceps* (Leidy, 1886) n. comb. et *P. roemeri* (Linstow, 1905) n. comb., sont transférées dans le genre *Pelecitus*, et il est suggéré qu'elles constituent des « captures » (*sensu* CHABAUD, 1965), d'espèces parasites d'oiseaux. Certains *Pelecitus* (*Loaina* sp. *sensu* BOTERO *et al.*, 1984) semblent ainsi être à l'origine de zoonoses. Dans un autre groupe de Filaires, *Rumenfilaria andersoni* Lankester et Snider, 1982, parasite de *Alces alces*, peut être interprété comme une « capture » de *Chandlerella* d'oiseaux. Une clé des espèces de *Pelecitus* est donnée ; les hôtes et la répartition géographique des espèces parasites d'oiseaux sont indiqués.

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INTRODUCTION

The genus *Pelecitus* Railliet and Henry, 1910, is the most widely distributed avian filarioid genus known, having been reported in at least 30 families of birds representing 16 orders. The worms occur free or in nodules around the muscles and tendons of the legs and feet and recent studies (GREVE *et al.*, 1982 ; PASTER, 1983 ; GREVE, *personal communication*) have diagnosed tenosynovitis associated with their presence in captive Psittaciformes. Unfortunately, however, identification of the species involved in these diseases is hindered by the fact that many of the 22 nominal species of *Pelecitus* are inadequately described.

The present study is an attempt to clarify the confused taxonomic status of these species. It is based on new material made available through the courtesy of several veterinarians in the United States who have removed specimens from psittacids surgically or at necropsy, material lent to us by curators of various world helminthologic collections, and the literature. We give herein an emended diagnosis of *Pelecitus*, redescrptions of those species of which we were able to obtain specimens, and descriptions of two new species. Each species redescription or description is accompanied by a list of the known hosts, the known geographic distribution of the parasite, and references to the pertinent literature. This same information is provided for those species of which we were unable to obtain specimens. Finally, it is proposed that two species of Dirofiliariinae from mammals be placed in *Pelecitus* and it is suggested that they are derived (i.e. "captures" *sensu* CHABAUD, 1965) from species in birds.

METHODS AND MATERIALS

Specimens were borrowed from various sources and the following abbreviations have been used : BM, British Museum (Natural History), London, England ; IRSNB, Institut Royal des Sciences Naturelles de Belgique, Bruxelles, Belgium ; MNHN, Muséum national

d'Histoire naturelle, Paris, France ; USNM, United States National Museum, Beltsville, Maryland, USA ; ZMB, Zoologisches Museum, Berlin, East Germany. Specimens given to us by Dr. J. H. GREVE (Dept. of Veterinary Pathology, College of Veterinary Medicine, Iowa State University, Ames, Iowa 50011, USA), Drs. M. WALSH and J. L. ALLEN (Special Clinical Sciences, College of Veterinary Medicine, University of Florida, Gainesville, Florida 32610, USA), Drs. W. BOYCE and R. E. BRADLEY (Dept. of Infectious Diseases, College of Veterinary Medicine, University of Florida, Gainesville, Florida 32610, USA), and Dr. T. PARROTT (Pembroke Park Animal Clinic, 3050 Country Club Lane, Pembroke Park, Florida 33009, USA) have been deposited in the MNHN. Dr. GREVE had originally obtained his specimens from Dr. R. NYE (Des Plaines, Illinois), Dr. S. CLUBB (Miami, Florida), Dr. M. B. PASTER (Carson, California), and Dr. E. SPINDEL (Ithaca, New York). Dr. D. SPRATT (Division of Wildlife and Rangelands Research, CSIRO, P.O. Box 84, Lyneham, ACT, 2602, Australia) provided specimens of *Dirofilaria roemeri*.

Specimens were studied in glycerin and in lactophenol. Ventral views of tails of males were frequently difficult to obtain because of the thick caudal alae and coiling of the tail. Therefore, some illustrations of male caudal morphology are presented in a slight lateral orientation and, unless indicated, are not to be interpreted as indicating asymmetrical caudal alae. To facilitate study of the tail, male specimens were also studied and rolled in water. All descriptions are based on mature specimens, and more specifically for females, only gravid specimens. Transverse sections were taken from the mid-body region and were done free-hand, using a mounted razor blade.

Microfilariae were either dissected from the anterior vagina of preserved female specimens or found adhered to the exterior cuticular surface of preserved adult worms. This precluded detailed study of microfilariae and therefore only total length and width and illustrations of the anterior and posterior extremities are given. A complete illustration of a typical microfilaria of a *Pelecitus* species can be found in VANDERBURGH *et al.* (1984).

Names of birds have been updated using SHARPE (1874-1898, vols. 1-27), PETERS (1979, vol. 1 (2nd ed.) ; 1934-1979, vols. 2-10, 12-15) ; and HOWARD and MOORE (1984). Names given by authors but which are now junior synonyms have been placed, after the modern name, in parentheses and preceded by “ = ”. Names which could not be verified are indicated by “ * ”.

The genus **PELECITUS**

HISTORY

Pelecitus was proposed by RAILLIET and HENRY (1910) to accommodate five filarioid species described in the mid 1800's from the legs and feet of birds in Brazil. The morphology of these species was poorly known and RAILLIET and HENRY were only able to give a brief generic diagnosis ; *P. helicinus* was designated as the type species. SKRJABIN (1916) gave a more detailed diagnosis of the genus but incorrectly designated *P. tercostatus* as the type species. The genus *Eulimdana* Founikoff, 1934, was placed in synonymy with *Peleci-*

tus by LI (1940) and the genus *Spirofilaria* Yamaguti, 1935, in synonymy with *Pelecitus* by LÓPEZ-NEYRA (1956). However, SONIN (1968) and BARTLETT *et al.* (1985) recognized *Eulimdana* as a valid genus and two species, i.e. *E. clava* (Wedl, 1856) and *E. mazzantii* (Railliet, 1893), which had been in *Pelecitus* are now in *Eulimdana*.

EMENDED DIAGNOSIS

Filarioidea, Onchocercidae, Dirofilarinae, *Pelecitus* : Body extremities bluntly rounded. Cuticle with transverse striations, without either longitudinal striations or bosses. Lateral alae extending from cervical region to caudal extremity. One or two non-salient post-deirids present within alae in posterior region of body. Cephalic extremity with four pairs of papillae. Pre-oesophageal cuticular ring present or absent. Œsophagus well developed, divided or undivided. Spicules subequal or unequal. Vulva near anterior extremity, in pre- to post-oesophageal position. Ovejector simple. Microfilaria with bluntly rounded anterior and posterior extremities, body width tapering from posterior 1/3-1/5 of body length to posterior extremity ; sheath present, width approximately same as anterior 2/3 of microfilarial body, length greater than length of microfilarial body. Parasites of birds and mammals, than generally associated with tendons and muscles near joints of legs and feet (rarely wings).

MORPHOLOGIC CHARACTERS

1 — *Form of body* : The form of the body of gravid female worms may be straight or slightly curved, i.e. without any tendency to coil or twist, it may be in the form of half to full circular coils, or it may be irregularly or regularly twisted. If regularly twisted, the body may form a loose to tight helix or spiral. Helix denotes a body in which the diameters of the rotations are uniform over the length of the specimen (i.e. like a string wound round a cylinder) and spiral denotes a body in which the diameters of the rotations increase (or decrease) over the length of the specimen (i.e. like a string wound round a cone). Combinations of “ circularly coiled ”, “ spiralled ”, “ loosely helical ”, and “ irregularly twisted ” may occur within the same species. “ Straight (or curved) ” and “ tightly helical ” do not occur in combination with other forms.

The form of the body of male worms also varies but the differences are less pronounced than in females and are not useful.

2 — *Cephalic papillae* : Cephalic papillae are considered “ markedly protuberant ” if they obviously rise above the level of the cephalic cuticle. Those considered “ not markedly protuberant ” may be visible as delicate extensions from the hypodermis to the external cuticular surface or as slightly salient structures.

3 — *Cuticular striations* : All species have transverse cuticular striations but only *P. polamaetus* has a cuticle that appears transversely ridged as well as striated. Interspecific differences in width of the cuticular striations are reported herein but their reliability as a diagnostic character is not known. Different fixatives may cause shrinkage or stretching of nematodes (FAGERHOLM and LÖVDHAL, 1984) ; it is not known which fixatives were originally used for most of the specimens examined in the present study.

4 — *Alae* : Alae along the lateral chord are referred to as lateral alae ; where they extend into the caudal region in males they are referred to as caudal alae. Lateral alae may be narrow or broad, depending on the species, and they may be symmetrical or asymmetrical, depending on the sex. Caudal alae may also be symmetrical or asymmetrical but this is an unreliable character as the asymmetry may be extremely slight and difficult to determine (see Methods and materials).

5 — *Pre-oesophageal ring* : Pre-oesophageal ring refers to the cuticularized structure present between the oesophagus and oral opening. In some species it is readily apparent, in others it is present but delicate, and in others absent. Among specimens of some species, however, it may be present and delicate, or absent, possibly as a result of a decrease in its prominence with an increase in the age of the worm (BARTLETT, 1984b). Thus, “ delicate ” as opposed to “ absent ” is not of taxonomic value although “ readily apparent ” as opposed to “ delicate or absent ” is.

6 — *Oesophagus* : The oesophagus may appear undivided, i.e. be muscular throughout its length. Or it may be distinctly or indistinctly divided into an anterior muscular portion and a posterior glandular portion. Caution must be exercised with this character, however, as the distinctness of the division may decrease with increasing age of adult worms (BARTLETT, 1984b). Thus, closer examination of adult worms, or developmental studies, may reveal that in some of the species in which the oesophagus is reported to be “ undivided ” it is in fact indistinctly divided.

7 — *Caudal papillae in male* : Different groups of papillae are present : pedunculate pre- to post-anal ones that extend into the alae, semi-pedunculate to sessile ones that occur between the aforementioned group and the caudal extremity, and peri-anal ones. In some species the numbers, size, and position of the pedunculate papillae extending into the alae are extremely variable ; these papillae are described together as one group [group (i)]. However, amongst other species the papillae extending into the alae can be divided into large pre-anals and smaller ad- to post-anals ; these are described as two separate groups [group (i) and group (ii), respectively]. The remaining caudal papillae exhibit more intraspecific variation and therefore are of less diagnostic value. “ Symmetric ” versus “ asymmetric ” in arrangement describes whether the positions of the papillae on one side are, or are not, a mirror image of those on the other side.

8 — *Inclusions within the caudal alae* : Granular or hyaline inclusions are present within the caudal alae of some species. However, they are not always present in all specimens of a single species and have diagnostic value only in combination with other characters.

9 — *Spicules* : “ Dissimilar ” indicates that the morphology of the left and right spicules is different. “ Stout ” denotes spicules which are strongly sclerotized, “ delicate ” those which are not. In species with stout spicules, the calomus and lamina of the left appear approximately equally sclerotized. In species with delicate spicules, the calomus of the left is generally more strongly sclerotized than the lamina. The distinction between calomus and lamina in the right spicule is not well defined.

“ Unequal ” denotes spicules in which the left and right are obviously of different length. “ Equal ” and “ subequal ” denote spicules which are similar or only slightly different in length.

10 — *Vulva* : The vulva may or may not be protuberant and this is a good diagnostic character, as is its accentric or central placement on the underlying tissue. In some species oval or tear-drop shaped cells are present adjacent to the vulva. The position of the vulva with regard to the oesophago-intestinal junction shows intraspecific variation in some species.

11 — *Vagina* : The vagina of all species is surrounded by circular muscles. There are, in addition in *P. tercostatus*, obvious longitudinal muscles around the anterior portion of the vagina. The length of the vagina, whether extremely short as in *P. tubercauda*, or considerably longer as in most other species, may be valuable. The exact length of the vagina is difficult to determine in many species, however, as it is obscured by convolutions of other portions of the reproductive tract.

12 — *Morphometrics* : There is considerable intraspecific variation in the measurements of the major morphologic structures, including spicules (tables 1, 2) and measurements alone are therefore not reliable diagnostic characters. The value of body length should be viewed cautiously as it may be influenced by the species of host, and the number and age of worms present (DISSANAIKE, 1967 ; SONIN, 1968 ; BARTLETT, 1984*b* ; BLACK, 1985).

13 — *Microfilarial sheath* : “ Loose ” sheath refers to the fact that the sheath extends (by an amount which shows intraspecific variation) past either or both the anterior and posterior extremities of the microfilarial body. It does not refer to the width of the sheath which is always approximately the same as the width of the anterior two-thirds of the microfilarial body.

PELECITUS SPECIES IN BIRDS

VALID SPECIES

1. *Pelecitus helycinus* (Molin, 1860)

Spiroptera helicina Molin, 1860 : 948-952. — DRASCHE, 1884 : 201, fig. 23 of pl. 13. — STOSSICH, 1897 : 87-88. — NOT COBBOLD, 1879 : 440.

Pelecitus helycinus : RAILLIET and HENRY, 1910 : 251. — SKRJABIN, 1916 : 747. — YORKE and MAPLESTONE, 1926 : 411-412. — TRAVASSOS, 1930 : 6-7, 10-11. — SKRJABIN and SHIKHOBALOVA,

1948 : 402. — LÓPEZ-NEYRA, 1956 : 98-99 ; 1957 : 209-239. — YAMAGUTI, 1961 : 300. — DISSANAIKE, 1967 : 101-102. — SONIN, 1968 : 352-354.

SPECIMENS : 1) Types : we were unable to locate them. 2) Material given to us by Drs. BOYCE and ALLEN, MNHN n° 40 DL, ex. *Ara auricollis* imported into USA from South America. 3) Material given to us by Dr. GREVE, MNHN n° 41 DL, ex. *Ara ararauna* imported into USA from South America.

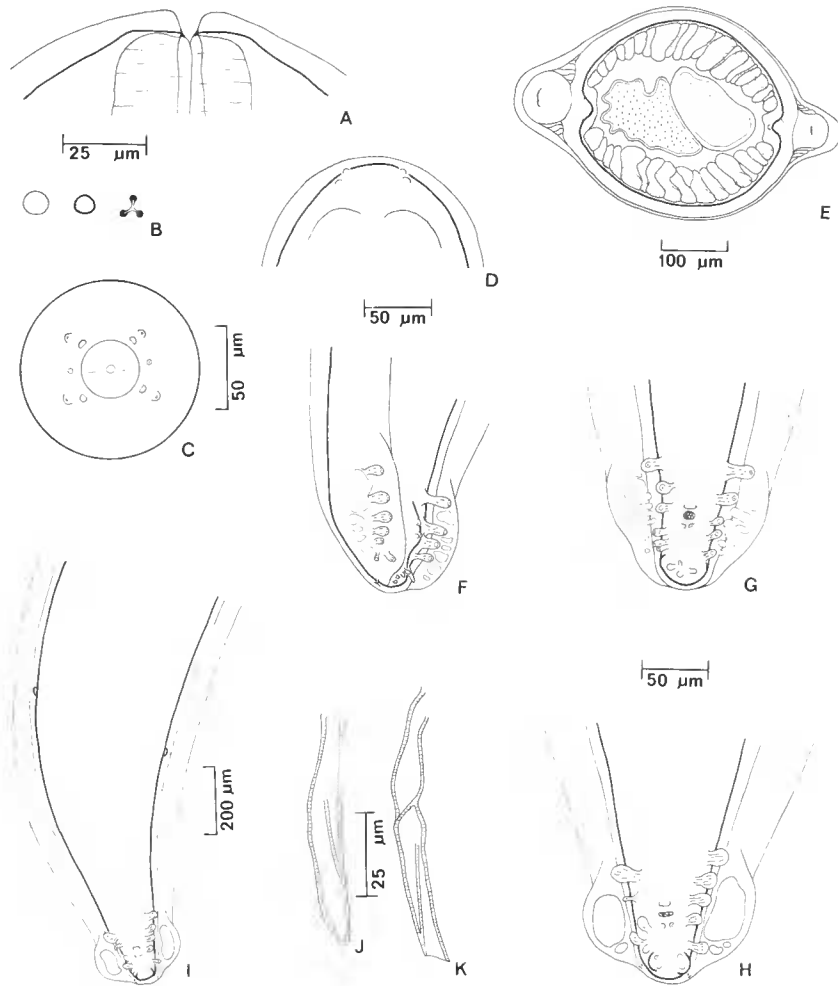


FIG. 1. — *Pelecitus helacinus* (Molin, 1860). ♂ : A, D, cephalic extremity, lateral views at level of oral opening and at cuticular surface ; B, apical views of oral opening at different levels ; C, en face ; E, transverse section of body ; F-H, tail, sub-lateral and ventral views ; I, posterior end, ventral view ; J, K, spicules, right and left.

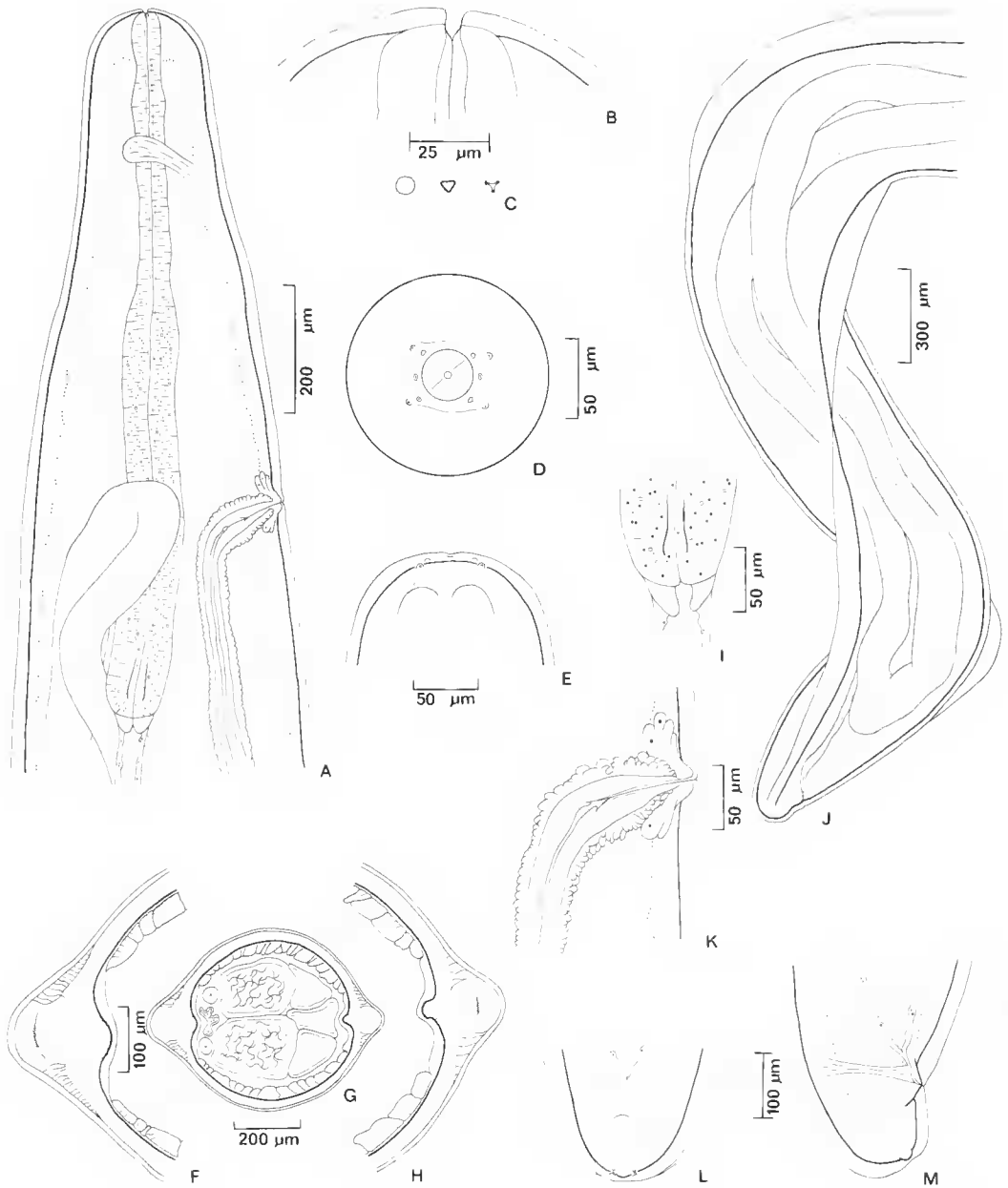


FIG. 2. — *Pelecitus helacinus* (Molin, 1860). ♀ : A, anterior end, lateral view ; B, E, cephalic extremity, lateral views at level of oral opening and at cuticular surface ; C, apical views of oral opening at different levels ; D, en face ; F-H, transverse sections of left side, whole body, and right side ; I, oesophago-intestinal junction ; J, posterior end ; K, vulva ; L, M, tail, ventral and lateral views.

REDESCRIPTION (based on specimens n^{os} 2 and 3 above ; figs. 1, 2, 17, tables 1, 2)

General : Body regularly twisted. Body width uniform over most of length but tapering gradually at both ends ; width from nerve ring to cephalic extremity uniform or decreasing slightly. Lateral alae asymmetrical, left larger than right. Cuticle thick, with strong transverse striations. Amphids not salient. Cephalic papillae not markedly protuberant. Pre-oesophageal ring present and delicate, or absent. Oesophagus divided, glandular portion wider than muscular.

Male : Body in form of dextral spiral or helix, 1-3 rotations present, outer diameter of rotation approximately 1-2 mm. Caudal alae symmetrical. Tail coiled 0.5-1 turn. Three groups of caudal papillae present as follows : (i) pedunculate pre- to post-anal papillae extending into alae, 4-8 on left side, 4-7 on right side, symmetrical or asymmetrical in arrangement, variable in size but anteriormost generally largest ; (ii) 2-5 sessile subterminal papillae, variable in size ; (iii) small, sessile peri-anal papillae, 1 anterior and 2 posterior to anus. Granular or hyaline inclusions present within caudal alae. Spicules stout, subequal, dissimilar. Post-deirids 0.15-0.50 mm from caudal extremity, one slightly anterior to other.

Female : Body in form of tight dextral helix, 3-5 rotations present, outer diameter of helix approximately 1.5-2 mm. Vulva at, or anterior to, oesophago-intestinal junction, not protuberant although centrally placed on cone of tissue extending slightly into cuticle of body wall. Cuticular lips of vulva thick. Tear-drop shaped cells present adjacent to vulva. Vagina directed posteriorly from vulva or immediately looping anteriorly to pass vulva, convoluted. Uteri convoluted, portions frequently present near vulva. Position of ovaries obscured by uteri. Post-deirids 1.0-2.5 mm from caudal extremity, one slightly anterior to other. Anus readily apparent.

Microfilaria (five specimens from anterior vagina) : Loose sheath present. Total length of body 185-205 μ m. Extremities bluntly rounded. Maximum width of anterior 4/5 of body 5-6 μ m, tapering to 2-3 μ m at caudal extremity.

LOCALITY : Type from Borba, Brazil. Others from Brazil (additional localities) ; " South America " (see Comments).

HOSTS : From MOLIN (1860), Cotingidae : *Xipholena punicea* (Pallas) (= *Ampelis pompadora*) (type), *Cephalopterus ornatus* Geoffroy Saint-Hilaire ; Cracidae : *Crax mitu* L. (= *Ourax mitu*) ; Phasianidae : *Odontophorus gujanensis* (Gmelin) (= *Perdix dentata*), *Odontophorus gujanensis rufinus* (Spix) (= *Perdix rufina*) ; Columbidae : *Columbina picui* (Temminck) (= *Columba picui*) ; Psittacidae : *Ara nobilis* (L.) (= *Psittacus guianensis*), *Anodorhynchus hyacinthinus* (Latham) (= *Psittacus hyacinthinus*) ; Cuculidae : *Piaya cayana* (L.) (= *Cuculus cayanus*) ; Trogonidae : *Trogon melanurus* Swainson, *Trogon curucui* L. (= *Trogon variegatus*) ; Alcedinidae : *Chloroceryle americana* (Gmelin) (= *Alcedo americana*) ; Ramphastidae : *Ramphastos tucanus* L. (= *Ramphastos erythrorhynchus*) ; Picidae : *Campephilus melanoleucos* (Gmelin) (= *Picus comatus*), *Veniliornis passerinus olivinus* (Natterer and Malherbe) (= *Picus olivinus*) ; Dendrocolaptidae : *Campylorhamphus procurvoides* (Lafresnaye) (= *Dendrocolaptes procurvus*) ; Furnariidae : *Anumbius anumbi* (Vieillot) (= *Anabates (Annubius) anthoides*), *Pseudoseisura c. cristata* (Spix) (= *Anabates cristatus*), *Anabates luscinioides** ; Formicariidae : *Thamnophilus sulfuratus**, *Cercomacra melanaria* (Menetries) (= *Myothera (Formicivora) melanaria*), *Formicarius colma ruficeps* (Spix) (= *Myothera ruficeps*) ; Tyrannidae : *Tyrannus melancholicus* Vieillot (= *Muscicapa despotes*), *Machetornis rixosus* (Vieillot) (= *Muscicapa rixosa*).; Muscicapidae : *Poliophtila duminicola* (Vieillot) (= *Culicivora duminicola*), *Ramphocaenus*

TABLE 1. — Major dimensions (range, in micrometers unless otherwise stated) of males of various species of *Pelecitus* from birds. (Figures in parentheses are from original species descriptions, all other figures represent measurements made in the present study.)

	No. of specimens	Total length (mm)	Maximum width	Width at nerve ring	Distance to nerve ring	Width left ala at mid body	Width striations at mid body
<i>P. helycinus</i>	5	6-10	300-400	150-180	170-210	75-90	3-4
<i>P. circularis</i>	?	(3-5)	(200)	—	—	—	—
<i>P. tercostatus</i> — MNHN	5	7-10	280-350	140-150	150-200	40-45	2
<i>P. fulicaeatrae</i> — BM	2	7-8	225-300	90-110	100-125	35-40	4-5
— ZMB	1	10	300	110	125	30	—
<i>P. armenica</i>	?	(9)	(602)	—	—	—	—
<i>P. anhingae</i>	5*	8-10	275-315	125-140	160-190	30-45	3-4
<i>P. polamaetus</i>	3*	8	290-340	110-125	150-175	35-45	2
<i>P. ceylonensis</i>	17 ^a	(4-6)	(185-300)	—	(125-150)	—	—
<i>P. galli</i>	4*/2 ^b	(9-11)	(400-500)	140	(140-160)	60-70	3-4
<i>P. barusi</i>	6*	(9-11)	(430-520)	—	(150-180)	—	—
<i>P. tubercauda</i>	6*/2 ^b	(5-6)	(270-335)	85-100	(115-145)	75-100	2-5
<i>P. andersoni</i>	4*	8-11	430-530	150-225	150-250	60-100	4-5
<i>P. chabaudi</i>	2*	6	350	110-115	150	22-27	2-4
<i>P. vuylstekae</i>	5*	8-9	320-380	135-145	125-170	30-45	2-4

	Muscular oesophagus	Glandular oesophagus	Total length oesophagus	Left spicule	Right spicule	Tail
<i>P. helycinus</i>	280-320	350-380	670-980	70-85	60-78	40-60
<i>P. circularis</i>	—	—	—	—	—	—
<i>P. tercostatus</i> — MNHN	270-300	450-580	720-860	105-122	75-85	50-62
<i>P. fulicaeatrae</i> — BM	n.d.	n.d.	425-450	80	70	40-50
— ZMB	n.d.	n.d.	510	—	—	40
<i>P. armenica</i>	—	—	—	(150)	(110)	(60)
<i>P. anhingae</i>	325-360	530-650	855-1010	80-95	58-65	45-58
<i>P. polamaetus</i>	270-350	550-630	820-980	110-130	75-80	50-55
<i>P. ceylonensis</i>	n.d.	n.d.	460-600	(68-82)	(55-70)	(40-55)
<i>P. galli</i>	n.d.	n.d.	(780-825)	(85-95)	(70-90)	(40-48)
<i>P. barusi</i>	n.d.	n.d.	(780-980)	(78-91)	(65-86)	(44-62)
<i>P. tubercauda</i>	—	—	(530-630)	(66-88)	(67-87)	(56-66)
<i>P. andersoni</i>	250-320	460-600	720-920	85-90	60-80	50-60
<i>P. chabaudi</i>	230	250-300	480-530	70-80	65	40-45
<i>P. vuylstekae</i>	250-340	520-650	785-990	80-100	60-75	50-55

* : Includes holotype or lectotype. a : not all measurements were based on 17 specimens. b : first figure represents number of specimens used in original description, second figure represents number of specimens used in present study. n.d. : not divided.

TABLE 2. — Major dimensions (range, in micrometers unless otherwise stated) of females of various species of *Pelecitus* from birds. (Figures in parentheses are from original species descriptions, all other figures represent measurements made in the present study.)

	No. of specimens	Total length (mm)	Maximum width	Width at nerve ring	Distance to nerve ring	Width left ala at mid body	Width striations at mid body
<i>P. helycinus</i>	5	17-20	520-620	185-200	175-215	120-160	5-8
<i>P. circularis</i>	2	12	400-410	200-250	250	50-60	4-5
<i>P. tercostatus</i> — MNHN	5	20-23	600-670	175-190	160-200	35-40	2-4
<i>P. fulicaeatrae</i> — BM	2	20-22	580-640	140	130-150	65-70	5-7
— ZMB	3	22-26	440-580	130-150	130-150	40-45	—
<i>P. armenica</i>	?	(15)	(817)	—	(160)	—	—
<i>P. anhingae</i>	3*	24-26	500-650	185-190	180-200	50-60	5-7
<i>P. polamaetus</i>	1*	18	620	140	180	125	5-6
<i>P. ceylonensis</i>	16 ^a	(6-10)	(320-460)	—	(120-155)	—	—
<i>P. galli</i>	5*/2 ^b	(15-20)	(550-650)	170-175	(170-190)	80-90	3-5
<i>P. barusi</i>	11*	(16-18)	(540-570)	—	(210-220)	—	—
<i>P. tubercauda</i>	9*/3 ^b	(8-9)	(410-480)	140-160	(140-175)	105-145	4-7
<i>P. andersoni</i>	4*	13-17	660-770	215-240	200-215	90-120	6-10
<i>P. chabaudi</i>	5*	12-14	450-530	140-175	150-190	20-25	4-8
<i>P. vuylstekae</i>	5*	19-25	500-700	150-210	160-235	35-50	4-5

	Muscular oesophagus	Glandular oesophagus	Total length oesophagus	Distance to vulva	Length of vagina (mm)	Width at anus	Tail
<i>P. helycinus</i>	380-400	520-650	910-1040	630-890	—	185-225	90-150
<i>P. circularis</i>	325-350	510-550	835-900	580-650	> 1.4	200-225	100-125
<i>P. tercostatus</i> — MNHN	315-375	580-690	940-1005	520-750	1.7-3.3	112-124	90-120
<i>P. fulicaeatrae</i> — BM	n.d.	n.d.	600-640	510-600	> 1.0	125-130	75-90
— ZMB	n.d.	n.d.	500-520	730-800	> 2.0	120-140	40-70
<i>P. armenica</i>	—	—	(935)	(560)	—	—	—
<i>P. anhingae</i>	310-350	600-620	920-950	520-700	2.0-3.0	150-200	100-140
<i>P. polamaetus</i>	300	600	900	500	—	150	75
<i>P. ceylonensis</i>	n.d.	n.d.	(580-700)	(335-400)	—	—	(50-88)
<i>P. galli</i>	n.d.	n.d.	(850-870)	(670-780)	> 0.6	200-220	(150-180)
<i>P. barusi</i>	n.d.	n.d.	(1100-1120)	(710-720)	—	—	(125-140)
<i>P. tubercauda</i>	—	—	(600-710)	(420-500)	(0.46**)	125-150	(60-112)
<i>P. andersoni</i>	360-435	500-600	905-960	750-780	> 1.2	135-200	85-150
<i>P. chabaudi</i>	225-350	350-450	625-770	480-800	> 1.2	180-240	50-120
<i>P. vuylstekae</i>	300-375	750-1000	1060-1400	500-700	1.4-2.4	150-225	135-175

* : Includes allotype or alloectotype. a : not all measurements were based on 16 specimens. b : first figure represents number of specimens used in original description, second figure represents number of specimens used in present study. n.d. : not divided. ** : *Vagina vera* of allotype.

	<i>P. helcinus</i>	<i>P. circularis</i>	<i>P. tercostatus</i>	<i>P. fulicaeatrae</i>	<i>P. armenica</i>	<i>P. anhingae</i>	<i>P. polamaetus</i>	<i>P. ceylonensis</i>	<i>P. galli</i>	<i>P. barusi</i>	<i>P. tubercauda</i>	<i>P. andersoni</i>	<i>P. chabaudi</i>	<i>P. vuylstekae</i>	<i>P. falconis</i> *	<i>P. serpentulus</i> *	<i>P. quadripapillosus</i> *	<i>P. ardeae</i> *
PICIFORMES																		
Ramphastidae	+																	
Picidae	+															+		
PASSERIFORMES																		
Dendrocolaptidae	+																	
Furnariidae	+																	
Formicariidae	+																	
Cotingidae	+																	
Tyrannidae	+																	
Muscicapidae	+																	
Emberizidae	+																	
Parulidae											+							
Icteridae	+																	
Corvidae	+	+						+										

* : *Species inquirendae*.

TABLE 4. — Geographic distribution by faunal region of species of *Pelecitus* (*species inquirendae* not included).

	Neotropical	Nearctic	Palaeartic	Ethiopian	Oriental	Australasian
<i>P. roemeri</i>						+
<i>P. scapiceps</i>		+				
<i>P. helcinus</i>	+					
<i>P. circularis</i>	+					
<i>P. tercostatus</i>	+					
<i>P. fulicaeatrae</i>		+	+	+		
<i>P. armenica</i>			+			
<i>P. anhingae</i>				+		
<i>P. polamaetus</i>				+		
<i>P. ceylonensis</i>					+	
<i>P. galli</i>						+
<i>P. barusi</i>	+					
<i>P. tubercauda</i>		+				
<i>P. andersoni</i>	+					
<i>P. chabaudi</i>			+			
<i>P. vuylstekae</i>				+		

melanurus Vieillot, *Turdoides fulvus* (Desfontaines) (= *Turdus fulvus*); Emberizidae : *Thraupis episcopus* (L.) (= *Tanagra episcopus*), *Tanagra melanops**; Icteridae : *Psarocolius yuracares* (Lafresnaye and d'Orbigny) (= *Cassicus yuracares*), *Icterus icterus* (L.) (= *Icterus croconotus*); Corvidae : *Cyanocorax cyanomelas* (Vieillot) (= *Corvus cyanomelas*). — From present study, Psittacidae : *Ara auricollis* Cassin, *Ara ararauna* (L.).

SITE IN HOST : Among tendons of legs and feet.

COMMENTS

RAILLIET and HENRY (1910) designated *P. helycinus* as the type species of *Pelecitus*. Unfortunately, only the tail of the male has been illustrated (DRASCHE, 1884).

MOLIN (1860) reported *P. helycinus* from birds in eighteen families representing eight orders. As a result, SONIN (1968) suggested *P. helycinus* was a species complex. However, DISSANAIKE (1967) clearly demonstrated through experimental infections that *P. ceylonensis* has a potentially wide host distribution which we believe may be true of other species. Consequently, we consider MOLIN's host list credible.

We identify our material as *P. helycinus* for the following reasons : 1) MOLIN (1860) indicated that the body is strongly helically coiled ["corpus in helicem tortum, spiris posterioribus angustioribus... diam. medius spirae 0.001-0.002 " (= 1-2 mm)]; 2) the lengths and widths of our specimens correspond to MOLIN's; 3) MOLIN's host list included Psittacidae; 4) DRASCHE's (1884) illustration resembles ours.

Specimens n^{os} 2 and 3 (see "Specimens" above) were obtained from psittacids imported into the USA. *Ara auricollis* is native to southern Brazil and northwestern Argentina and *A. ararauna* occurs from eastern Panama to Paraguay and southern Brazil (HOWARD and MOORE, 1984).

COBBOLD (1879) refers to specimens from "red partridge" (presumably collected in Britain but locality not specified) as *P. helycinus*. This identification, based solely on finding the specimens in the feet, is likely incorrect.

STOSSICH (1897) and TRAVASSOS (1930) give "*Conorus pavua**" and "*C. parvus**" as hosts listed by MOLIN (1860). However, MOLIN does not list these birds.

2. *Pelecitus circularis* (Molin, 1860)

Spiroptera circularis Molin, 1860 : 922-924. — DRASCHE, 1884 : 194-195, fig. 22 of pl. 13. — STOSSICH, 1897 : 87.

Pelecitus circularis : RAILLIET and HENRY, 1910 : 251. — YORKE and MAPLESTONE, 1926 : 412. — TRAVASSOS, 1930 : 11. — SKRJABIN and SHIKHOBALOVA, 1948 : 398, 400. — LÓPEZ-NEYRA, 1956 : 98-99; 1957 : 214, 225. — DISSANAIKE, 1967 : 102. — SONIN, 1968 : 358.

Spiroptera pistillaris Molin, 1860 : 955. — DRASCHE, 1884 : 201, fig. 17 of pl. 13.

SPECIMENS : 1) Types : we were unable to locate them. 2) Material (2 gravid females) given to us by Dr. PARROTT, MNHN n^o 42 DL, ex. *Ara auricollis* imported into USA from South America.

REDESCRIPTION (based on specimens n^o 2 above; fig. 3, table 2)

Female : Body in form of 1-1.5 circular coils. Cuticle thick, with strong transverse striations. Lateral alae asymmetrical, left slightly larger than right. Amphids not

salient. Cephalic papillae not markedly protuberant. Pre-oesophageal ring absent. Œsophagus indistinctly divided. Vulva anterior to Œsophago-intestinal junction, centrally placed on markedly protuberant cone of tissue. Cuticular lips of vulva thin. Vagina directed posteriorly from vulva, convoluted. Uteri convoluted. Positions of ovaries not determined. Post-deirids 2.7-3.4 mm from caudal extremity, one slightly anterior to other. Anus visible as delicate slit.

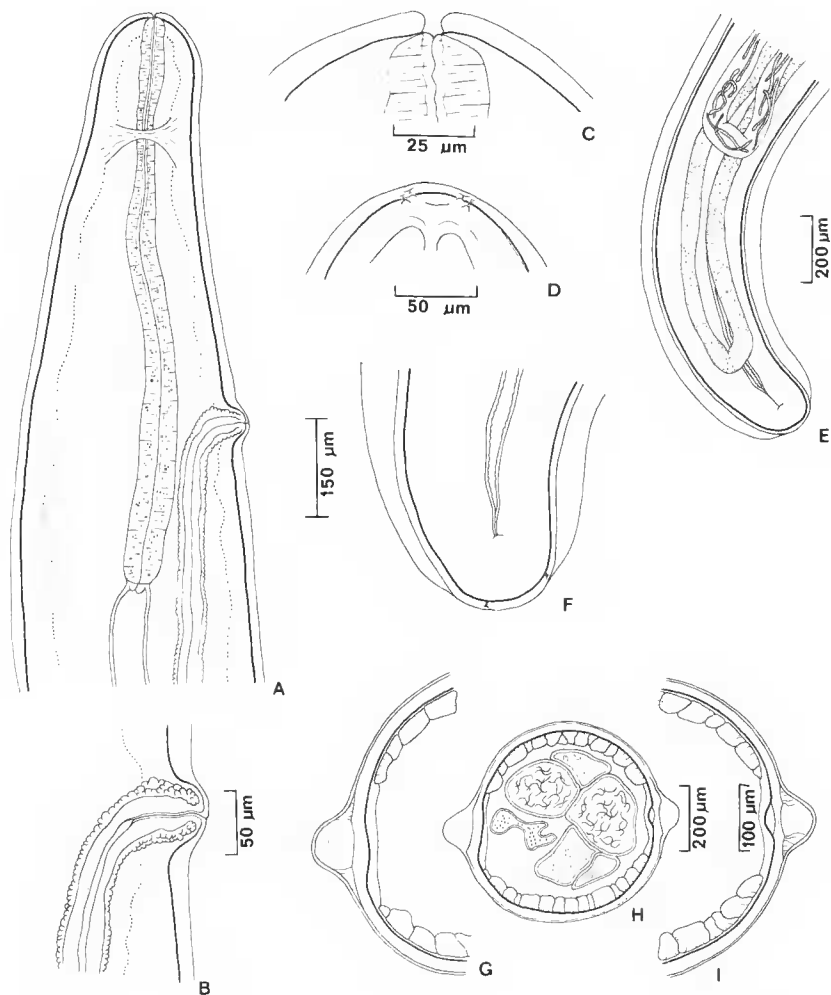


FIG. 3. — *Pelecitus circularis* (Molin, 1860). ♀ : A, anterior end, lateral view ; B, vulva ; C, D, cephalic extremity, lateral view at level of oral opening and at cuticular surface ; E, posterior end ; F, tail, ventral view ; G-I, transverse sections of left side, whole body, and right side.

LOCALITY : Type from Caicara, Brazil. Others from Brazil (additional localities) ; “ South America ” (see Comments).

HOSTS : From MOLIN (1860), Corvidae : *Cyanocorax cyanomelas* (Vieillot) (= *Corvus cyanomelas*) (type), *Cyanocorax cristatellus* (Temminck) (= *Corvus cristatellus*) ; Psittacidae : *Ara ararauna* (L.) (= *Psittacus ararauna*), *Ara macao* (L.) (= *Psittacus macao*), *Anodorhynchus hyacinthinus* (Latham) (= *Psittacus hyacinthinus*), *Amazona agilis* (L.) (= *Psittacus agilis*), *Pionus chalcopterus* (Fraser) (= *Psittacus haemorrhous*) ; Strigidae : *Strix magellanica**. — From present study, Psittacidae : *Ara auricollis* Cassin.

SITE IN HOST : Among tendons of feet.

COMMENTS

MOLIN (1860) described the body as forming a circle, i.e. “ corpus circulariter inflexum ” (cf. SONIN, 1968). It is on this basis that we identify our material as *P. circularis* ; also MOLIN's host list included Psittacidae.

Our specimens of *P. circularis* were obtained from *A. auricollis* imported into the USA. *Ara auricollis* is native to southern Brazil and northwestern Argentina (HOWARD and MOORE, 1984).

DRASCHE (1884) synonymized *S. circularis* and *S. pistillaris*. Only the tail of the male had previously been illustrated (DRASCHE, 1884).

3. *Pelecitus tercostatus* (Molin, 1860)

Spiroptera tercostata Molin, 1860 : 947. — DRASCHE, 1884 : 200, fig. 21 of pl. 13. — STOSSICH, 1897 : 89-90.

Pelecitus tercostatus : RAILLIET and HENRY, 1910 : 251. — SKRJABIN, 1916 : 748-750, figs. 18-20 of pl. 25. — TRAVASSOS, 1930 : 11-12, figs. 13-18 of pl. 2. — BAYLIS, 1944 : 799. — SKRJABIN and SHIKHOBALOVA, 1948 : 396-397. — SCHUURMANS-STEKHOFEN, 1952 : 386-388. — LÓPEZ-NEYRA, 1956 : 102 ; 1957 : 213. — YAMAGUTI, 1961 : 300. — DISSANAIKE, 1967 : 102. — SONIN, 1968 : 366-368.

Filaria calamiformis Schneider, 1866 : 90. — STOSSICH, 1897 : 32.

Pelecitus calamiformis : SKRJABIN, 1916 : 748-750. — SKRJABIN and SHIKHOBALOVA, 1948 : 398, 400. — LÓPEZ-NEYRA, 1956 : 99 ; 1957 : 213. — DISSANAIKE, 1967 : 102. — SONIN, 1968 : 357-358. — GREVE *et al.*, 1982 : 431-436.

Spirofilaria calamiformis : BAYLIS, 1944 : 799.

SPECIMENS : 1) Types : we were unable to locate them. 2) BM n° 1984. 4590-4594 (catalogued as *P. sp.* (?*tercostatus*)), ex. *Pionus* sp. collected by A. G. GREENWOOD. 3) ZMB n° 852 (catalogued as *P. calamiformis*, syntypes), ex. *Amazona a. aestiva* in Brazil, collected by ALFERS and SELBO. 4) ZMB n° 38 (catalogued as *P. calamiformis*), ex. *Psittacus* sp. in Brazil. 5) Material given to us by Dr. WALSH, MNHN n° 43 DL, ex. *Amazona tucumana* imported into USA from South America. 6) Material given to us by Dr. GREVE, MNHN n° 44 DL, ex. *Amazona tucumana* imported into USA from South America. 7) Material given to us by Dr. GREVE, MNHN n° 45 DL, ex. ?*Pionus m. maximiliani* imported into USA from South America.

REDESCRIPTION (based on specimens n^{os} 3, 5 above ; figs. 4, 5, 17, tables 1, 2)

General : Form of body showing slight sexual dimorphism. Maximum width at mid-body, tapering gradually towards extremities. Symmetry of lateral alae showing sexual dimorphism. Cuticle thick, with fine transverse striations. Amphids not salient. Cephalic papillae not markedly protuberant. Pre-oesophageal ring present, readily apparent. Œsophagus distinctly divided.

Male : Longitudinal axis of posterior 1/3 of body with gradual 1/4-1/2 rotation. Lateral alae asymmetrical, left larger than right ; width of alae increasing markedly in pos-

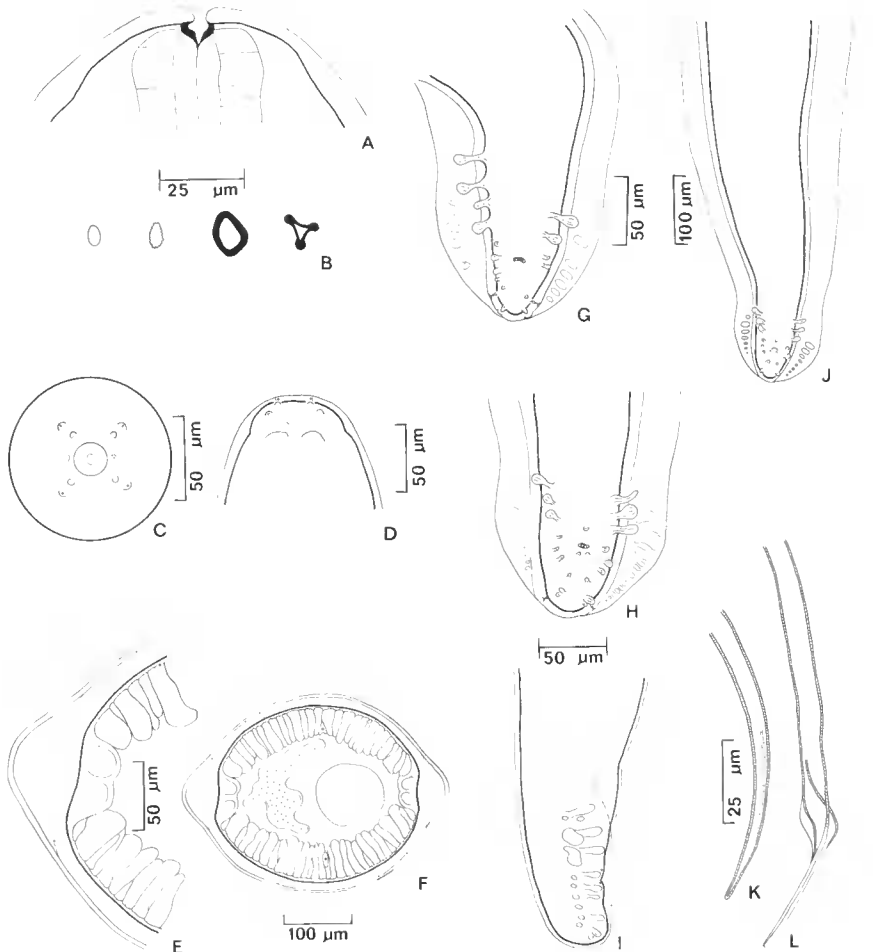


FIG. 4. — *Pelecitus tercostatus* (Molin, 1860). ♂ : A, D, cephalic extremity, lateral views at level of oral opening and at cuticular surface ; B, apical views of oral opening at different levels ; C, en face ; E, F, transverse sections of left side and whole body ; G-I, tail, ventral and lateral views ; J, posterior end, ventral view ; K, L, spicules, right and left.

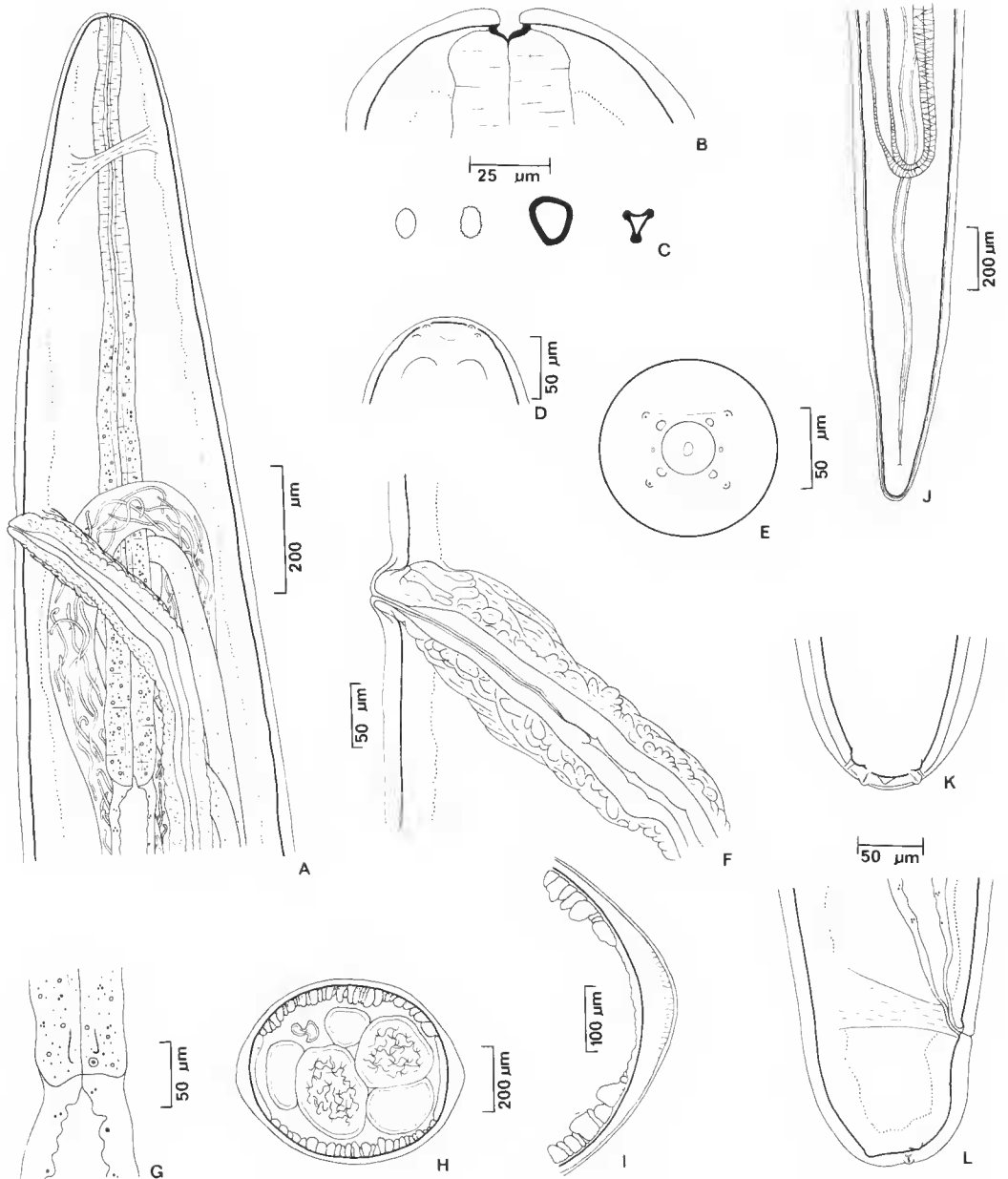


FIG. 5. — *Pelecitus tercostatus* (Molin, 1860). ♀ : A, anterior end, lateral view ; B, D, cephalic extremity, lateral views at level of oral opening and at cuticular surface ; C, apical views of oral opening at different levels ; E, en face ; F, vulva ; G, oesophago-intestinal junction ; H, I, transverse sections of whole body and right side ; J, posterior end ; K, L, tail, ventral and lateral views.

terior 1/3 of body. Caudal alae symmetrical. Tail coiled 0.5 turn. Four groups of caudal papillae present as follows : (i) large, pedunculate pre-anal papillae extending into alae, 1-3 on left side, 3-4 on right side, symmetrical or asymmetrical in arrangements ; (ii) 3-4 pairs of smaller pedunculate ad- to post-anal papillae extending into alae, each side forming a crescent ; (iii) 1-2 pairs terminal papillae ; (iv) small, sessile peri-anal papillae, 0-1 anterior and 0-2 posterior to anus. Hyaline or granular inclusions present within caudal alae. Spicules delicate, unequal, dissimilar. Post-deirids 0.4-0.7 mm from caudal extremity, one slightly anterior to other.

Female : Body straight or curved, not twisted or coiled. Alae symmetrical. Vulva anterior to oesophago-intestinal junction, centrally placed on markedly protuberant cone of tissue. Cuticular lips of vulva thin. Vagina directed posteriorly from vulva, convoluted ; proximal portion surrounded by circular and longitudinal muscles, remainder surrounded by circular muscles only. Uteri convoluted, portions frequently present near vulva. One ovary present in anterior half of body, other in posterior third. Post-deirids 2.5-4.5 mm from caudal extremity, one generally considerably anterior to other. Anus readily apparent. 2-4 sessile papillae present on caudal extremity.

Microfilaria (ten specimens adhered to cuticle of female) : Loose sheath present. Total length of body 204-268 μ m. Extremities bluntly rounded. Maximum width of anterior 2/3 of body 5-6 μ m, tapering to 2 μ m at caudal extremity.

LOCALITY : Type from Murungaba, Brazil. Others from Brazil (additional localities), Argentina, Paraguay, " South America " (see Comments).

HOSTS : Psittacidae : From MOLIN (1860), *Amazona a. aestiva* (L.) (= *Psittacus aestivus*) (type), *Pionus maximiliani* (Kuhl) (= *Psittacus maximiliani*). — From SCHNEIDER (1866), *Amazona a. aestiva* (L.) (= *Psittacus aestivus*). — From SKRJABIN (1916), *Psittacus* sp., *Amazona aestivus* (L.) (= *Psittacus aestivus*), *Pionus maximiliani* (Kuhl) (= *Psittacus maximiliani*). — From TRAVASSOS (1930), *Amazona aestiva* (L.). — From SCHUURMANS-STEKHOFEN (1952), *Pionus maximiliani* (Kuhl). — From GREVE *et al.* (1982) (specimens n° 7 above), ?*Pionus m. maximiliani* (Kuhl). — From present study, *Amazona tucumana* (Cabanis). BM specimens : *Pionus* sp.

SITE IN HOST : Among tendons and muscles of legs and feet, rarely in wings.

COMMENTS

SKRJABIN (1916) suggested that *P. calamiformis* and *P. tercostatus* were synonyms and TRAVASSOS (1930) made the synonymy. BAYLIS (1944) disagreed, stating that *P. calamiformis* had asymmetrical caudal alae and papillae which in *P. tercostatus* are symmetrical. However, caudal alae, whether symmetrical or not, may appear " asymmetrical " if not observed in perfect ventral view, a difficult orientation to obtain because of the coiling of the tail and thick caudal alae. We attribute the differences between the caudal alae depicted by SCHNEIDER (1866) and TRAVASSOS (1930) and those by DRASCHE (1884) and SKRJABIN (1916) to this difficulty. The symmetry or asymmetry of the caudal papillae exhibits intraspecific variation, as does their number (cf. DISSANAIKE, 1967).

SCHNEIDER's (1866) type material of "*P. calamiformis*" (ZMB n° 852), which had previously dried out (HARTWICH, personal communication) and is in poor condition, con-

sists of two species. One, unidentifiable to genus, may belong to Dicheilonematidae (Diplostriaenoidea). The other is recognizable as *Pelecitus*.

We identify our material (see n^{os} 5-7 in "Specimens" above) as *P. tercostatus* for the following reasons: 1) MOLIN (1860), SCHNEIDER (1866), SKRJABIN (1916), and TRAVASSOS (1930) do not mention any tendency of the body of the female to twist or coil; 2) longitudinal muscles are visible around the vagina in SCHNEIDER's material; 3) the only known hosts are Psittaciformes.

The most frequently observed caudal papillae pattern amongst our specimens was: (i) 3 pairs; (ii) 4 pairs; (iii) 2 pairs; (iv) 1 anterior and 2 posterior.

Specimens n^{os} 5-7 (see "Specimens") were obtained from psittacids imported into the USA. *Amazona tucumana* is native to southeastern Bolivia and northern Argentina, and *P. m. maximiliani* occurs in northeastern Brazil (HOWARD and MOORE, 1984).

SKRJABIN (1916) redescribed *P. tercostatus* but incorrectly considered it to be the type species. TRAVASSOS (1930) redescribed *P. tercostatus*; however, the spicule and tail measurements given do not correspond to those of the illustrations. SCHUURMANS-STEKHOVEN (1952) also redescribed the species.

4. *Pelecitus fulicaeatrae* (Diesing, 1861)

Nematodum Fulicae atrae Diesing, 1861 : 724.

Nematoideum Fulicae atrae Crisp : LINSTOW, 1899 : 16.

Nematoideum fulicaeatrae : STILES and HASSALL, 1920 : 84, 604, 606.

Spirofilaria fulicaeatrae : BAYLIS, 1944 : 796-799. — YAMAGUTI, 1961 : 301-302, fig. 306 of pl. 34. PIKE, 1969 : 167-172.

Pelecitus fulicaeatrae : LÓPEZ-NEYRA, 1956 : 98, 100; 1957 : 206-207. — DOLLFUS *et al.*, 1961 : 226, 313. — DISSANAIKE, 1967 : 101-102. — ANDERSON, 1968 : 191, 196, fig. 43 (not fig. 44). — MEREDOV *et al.*, 1970 : 63-69. — VASSILIADIS, 1970 : 53. — DISSANAIKE and FERNANDO, 1974 : 201-202. — VANDERBURGH *et al.*, 1984 : 364-366. — In part : SONIN, 1968 : 360-363. — BARUS *et al.*, 1978 : 245-246.

Spiroptera helix Linstow, 1899 : 16, figs. 42, 70; 1909 : 64, fig. 38.

Pelecitus helix : SKRJABIN and SHIKHOBALOVA, 1948 : 402-403. — YAMAGUTI, 1961 : 301-302. — In part : OSHMARIN, 1950 : 186, 188; 1963 : 231-235.

Spirofilaria podicipitis Yamaguti, 1935 : 416-418. — SKRJABIN and SHIKHOBALOVA, 1948 : 411-412. — YAMAGUTI, 1961 : 301-302.

Pelecitus podicipitis : SONIN, 1968 : 363-365. — BARUS *et al.*, 1978 : 246-247.

SPECIMENS : 1) Types : we were unable to locate them. 2) ZMB n° 3579 (listed as *P. helix*, syntypes), ex. *Fulica atra* at Emden, Germany, collected by J. DEWITZ. 3) USNM n° 77837, ex. *Podiceps grisegena* at Cow Lake, Alberta, Canada, specimens of VANDERBURGH *et al.* 4) BM n° 1985.1-10, ex. *Gallinula chloropus* at Worth Matravers, Dorset, England, collected by C. STOATE. 5) MNHN n° CXV 494-E, ex. *Tachybaptus ruficollis* at Richelieu, France, specimens of DOLLFUS *et al.*

REDESCRIPTION (based on specimens n^{os} 2-5 above; fig. 6, tables 1, 2)

General : Body regularly twisted. Body width uniform over most of length but tapering gradually at both ends. Lateral alae asymmetrical, left larger than right. Cuticle thick, with fine transverse striations. Amphids not salient. Cephalic papillae not markedly protuberant. Pre-oesophageal ring present, delicate. Oesophagus not externally divided, posterior portion slightly swollen.

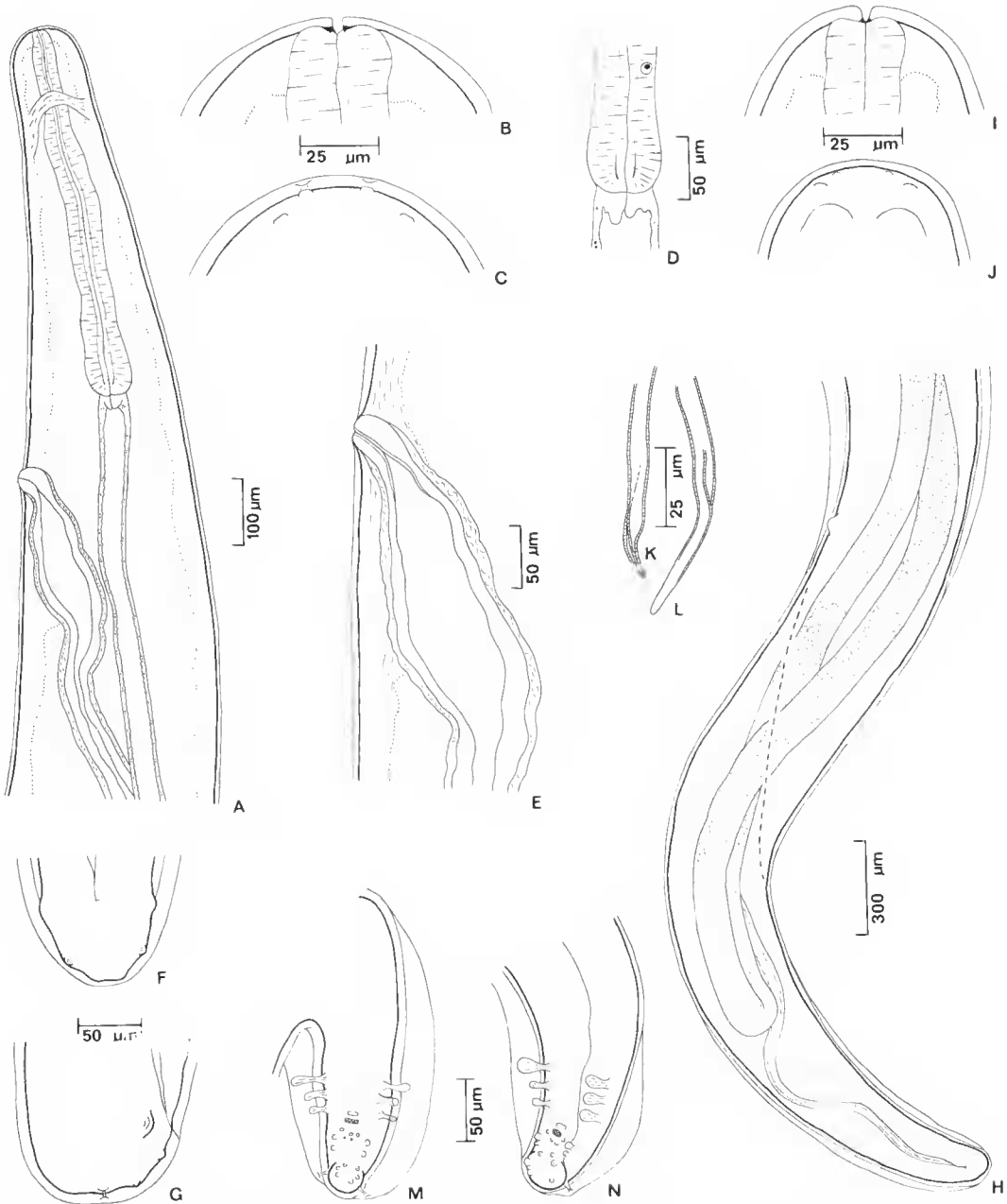


FIG. 6. — *Pelecitus fulicaeatrae* (Diesing, 1861). A-H, ♀; I-N, ♂ (Note : A-G, I, J, N, specimens from ZMB ; H, K-M, specimens from BM) : A, anterior end, lateral view ; B, C, cephalic extremity, lateral views at level of oral opening and at cuticular surface ; D, oesophago-intestinal junction ; E, vulva ; F, G, tail, ventral and lateral views ; H, posterior end ; I, J, cephalic extremity, lateral views at level of oral opening and at cuticular surface ; K, L, spicules, right and left ; M, N, tail, ventral and sub-lateral views.

Male : Body in form of loose dextral spiral or helix, 1-3 rotations present, outer diameter of rotation approximately 1-2 mm. Caudal alae asymmetrical, left larger than right (specimens n^{os} 2-4) or right larger than left (specimen n^o 5). Tail coiled 0.5-1 turn. Four groups of caudal papillae present as follows : (i) 3 large, pedunculate pre-anal pairs extending into alae, symmetrical in arrangement ; (ii) 2 pairs of smaller, sessile to semi-pedunculate post-anal papillae extending into alae, symmetrical in arrangement ; (iii) 3 pairs of small, sessile papillae between previous group and caudal extremity, symmetrical or asymmetrical in arrangement, occasionally forming circle ; (iv) small, sessile peri-anal papillae, 1 anterior and 4-5 posterior to anus. Hyaline inclusions rarely present within caudal alae. Spicules delicate, unequal, dissimilar. Post-deirids 0.1-0.4 mm from caudal extremity, one slightly anterior to other.

Female : Body in form of loose to medium tight helix, 3-9 rotations present, outer diameter of helix approximately 1-3 mm. Alae symmetrical. Vulva posterior to oesophago-intestinal junction in specimens n^{os} 2 and 3, at or anterior to junction in specimens n^o 4 ; centrally placed on slightly protuberant cone of tissue. Cuticular lips of vulva thin. Vagina directed posteriorly from vulva. Uteri convoluted, portions occasionally present near vulva. Position of ovaries obscured by uteri. Post-deirids 2.5-4.2 mm from caudal extremity, one markedly anterior to other. Anus obscure. Small, sessile papillae present on caudal extremity.

LOCALITY : Type from Britain (specific locality not given). Others from Britain (additional locality), Germany, USSR, Japan, France, Canada, Madagascar.

HOSTS : From DIESING (1861), Rallidae : *Fulica atra* L. (type). — From LINSTOW (1899), Rallidae : *Fulica atra* L. — From YAMAGUTI (1935), Podicipedidae : *Tachybaptus ruficollis japonicus* Hartert (= *Podiceps r. japonicus*). — From BAYLIS (1944), Rallidae : *Porzana pusilla obscura* Neumann ; Podicipedidae : *Tachybaptus ruficollis* (Pallas) (= *Podiceps ruficollis*). — From DOLLFUS *et al.* (1961), Podicipedidae : *Tachybaptus ruficollis* (Pallas) (= *Podiceps ruficollis*). — From SONIN (1968) (see also Comments), Anatidae : *Aix galericulata* (L.) ; ?Accipitridae : *Pernis apivoris* (L.), *Circus melanoleucus* (Pennant), *Circus aeruginosus* (L.) ; Laridae : *Chlidonias nigra* L. — From PIKE (1969), Rallidae : *Gallinula chloropus* (L.). — From MEREDOV *et al.* (1970), Coraciidae : *Coracias garrulus* L. — From VASSILIADES (1970), Mesitornithidae : *Meseonas* sp. — From BARUS *et al.* (1978) (see also Comments). ?Ardeidae : *Ardea cinerea* L., *Ardea purpurea* L., *Egretta alba* (L.) (= *Ardea alba*), *Botaurus stellaris* (L.) ; ?Pandionidae : *Pandion haliaetus* (L.) ; Laridae : *Larus ridibundus* L. — From VANDERBURGH *et al.* (1984), Rallidae : *Fulica americana* Gmelin ; Podicipedidae : *Podiceps grisegena* (Boddaert), *Podiceps nigricollis* Brehm (= *Podiceps caspicus*), *Podiceps auritis* (L.). BM specimens : Rallidae : *Gallinula chloropus* (L.).

SITE IN HOST : Among tendons and muscles of legs, particularly near knee joint.

COMMENTS

CRISP (1853) mentioned but did not name worms from the knee joints of *Fulica atra* in Britain. Without having seen CRISP's specimens, DIESING (1861) named them *Nematodum Fulicae atrae*. LINSTOW (1899) briefly described worms from the knee joints of *F. atra* in Germany as *Spiroptera helix* and placed *N. Fulicae atrae* in junior synonymy with *S. helix*. BAYLIS (1944) pointed out that DIESING's name was senior and he also considered *Spirofilaria podicipitis* from *Tachybaptus ruficollis* in Japan to be a synonym of DIESING's species.

SONIN (1968) and BARUS *et al.* (1978) did not accept the latter synonymy, stating that lateral alae were absent in *P. fulicaeatrae* but present in *P. podicipitis*. We, however, accept the synonymies of BAYLIS (1944) as lateral alae were present on all specimens examined, including LINSTOW's (ZMB n° 3579) and those (BM n° 1985.1-10) from Britain, the country where CRISP's specimens were collected. VANDERBURGH *et al.* (1984) also accepted BAYLIS's synonymies.

YAMAGUTI (1961) did not accept the synonymy of *P. fulicaeatrae* and *P. podicipitis* stating that one pair of caudal papillae were much more anterior than the remainder in the *P. podicipitis*. This difference was not observed in specimens from species of Podicipedidae in Europe and North America and YAMAGUTI (1935) may have considered the post-deirids as papillae. He did not illustrate male "*P. podicipitis*" and we were unable to borrow his specimens.

SONIN (1968) and BARUS *et al.* (1978) list numerous references in the Russian literature and VANDERBURGH *et al.* (1984) list two theses which are not included in the above literature list, although the hosts given in these articles are included.

Reports of *P. fulicaeatrae* from Falconiformes (SONIN, 1968 ; BARUS *et al.*, 1978) require confirmation as the specimens may have been misidentified ; species in Falconiformes in the Old World include *P. armenica*, *P. chabaudi* n. sp., *P. falconis* sp. *inquirenda*, and *P. polamaetus*. Failure to recognize these different species may be the reason why OSHMARIN (1950, 1963, in SONIN, 1968) in describing *P. fulicaeatrae* stated "especially variable is the caudal end of the male : the length and form of the spicules, position and form of the caudal papillae and the width and length of the caudal wings...". Redescriptions of *P. fulicaeatrae* which may have been partially based on specimens from Falconiformes (OSHMARIN, 1950, 1963, in SONIN, 1968 ; BARUS *et al.*, 1978) should be viewed with caution.

Pelecitus fulicaeatrae has also been redescribed by BAYLIS (1944), SKRJABIN and SHIKHOBALOVA (1948), PIKE (1969), MEREDOV *et al.* (1970), and VANDERBURGH *et al.* (1984). YAMAGUTI (1935) illustrated the female only. ANDERSON (1968) illustrated the *en face* view (fig. 43, not fig. 44, see BARTLETT *et al.*, 1985).

We do not accept the synonymy of *P. fulicaeatrae* and *P. vuylstekae* nom. nov. (= *P. ardeae* Vuylsteke) suggested by BARUS *et al.* (1978) (see Comments under *P. vuylstekae*) and reports of *P. fulicaeatrae* from Ardeidae in Europe and Asia by these authors require confirmation.

BAYLIS (1944) identified specimens from *Porzana pusilla obscura* as *P. fulicaeatrae*. However, it was not clear where the infection was acquired as the bird had been collected in Madagascar then held in captivity in the gardens of the Zoological Society of London. VASSILIADIS (1970), however, reported *P. fulicaeatrae* in native Madagascan birds.

COBBOLD (1879) mentioned worms "spirally coiled among the muscles and tendons near the lower end of the tibia" in *Tachybaptus ruficollis* (= *Podiceps minor*) and *Gallinula chloropus* (collection locality not stated but presumably in Britain) and stated that they likely were "sexually imperfect female examples of *Filaria acuta* hitherto found in the abdomen of grebes". His specimens were not available to us but they probably were *P. fulicaeatrae*.

5. *Pelecitus armenica* Chertkova, 1945

Pelecitus armenica Chertkova, 1945 : 314-316. — SKRJABIN and SHIKHOBALOVA, 1948 : 397-400. — LÓPEZ-NEYRA, 1956 : 99 ; 1957 : 201. — SULTANOV *et al.*, 1960 : 58-63. — SONIN, 1968 : 355-357. — DISSANAIKE and FERNANDO, 1974 : 201-202.
Pelecitus armenicus Chertkova : YAMAGUTI, 1961 : 300.

SPECIMENS : Types presumably housed in a collection in the USSR. We were unable to locate them.

LOCALITY : Type from Armenia Region, USSR.

HOST : From CHERTKOVA (1945), Accipitridae : *Circus aeruginosus* (L.) (type)

SITE IN HOST : Articulation socket of tibia.

COMMENTS : See Comments under *P. fulicaeatrae* with regard to reports from Falconiformes.

6. *Pelecitus anhingae* Vuylsteke, 1957

Pelecitus anhingae Vuylsteke, 1957 : 15-17. — SONIN, 1968 : 354-355. — DISSANAIKE and FERNANDO, 1974 : 201-202.

SPECIMENS : Types (including lectotype, allolectotype, paralectotypes) : IRSNB n° “ stat. 1541 — II/fd/17 — 15.1.1952 ”.

REDESCRIPTION (based on types, figs. 7, 8, 17, tables 1, 2)

General : Body twisted or coiled, pattern showing sexual dimorphism. Body width uniform over most of length but tapering gradually at both ends. Lateral alae asymmetrical, left larger than right. Cuticle thin, with strong transverse striations. Amphids and cephalic papillae markedly protuberant. Pre-oesophageal ring present, readily apparent. Oesophagus distinctly divided, glandular portion markedly granular and broader than muscular.

Male : Body in form of loose dextral spiral ; 1-3 rotations present, outer diameter of spiral approximately 1-3 mm. Caudal alae symmetrical. Tail coiled 0.5-1 turn. Four groups of caudal papillae present as follows : (i) 2-3 large, pedunculate pre-anal pairs extending into alae, symmetrical in arrangement ; (ii) 2-3 smaller, pedunculate ad- to post-anal pairs extending into alae, symmetrical or asymmetrical in arrangement ; (iii) 2-3 pairs of small, sessile papillae between previous group and caudal extremity, symmetrical in arrangement ; (iv) small, sessile peri-anal papillae, 0-2 lateral or slightly anterior to anus, 2-3 immediately posterior to anus. Hyaline inclusions occasionally present within caudal alae. Spicules delicate, unequal, dissimilar. Post-deirids 0.2-0.6 mm from caudal extremity, one slightly anterior to other.

Lectotype (male) : Total length 10 mm. Maximum width (mid body) 315 μ m. Transverse striations 3-4 μ m wide at mid body. Width of left lateral ala at mid body

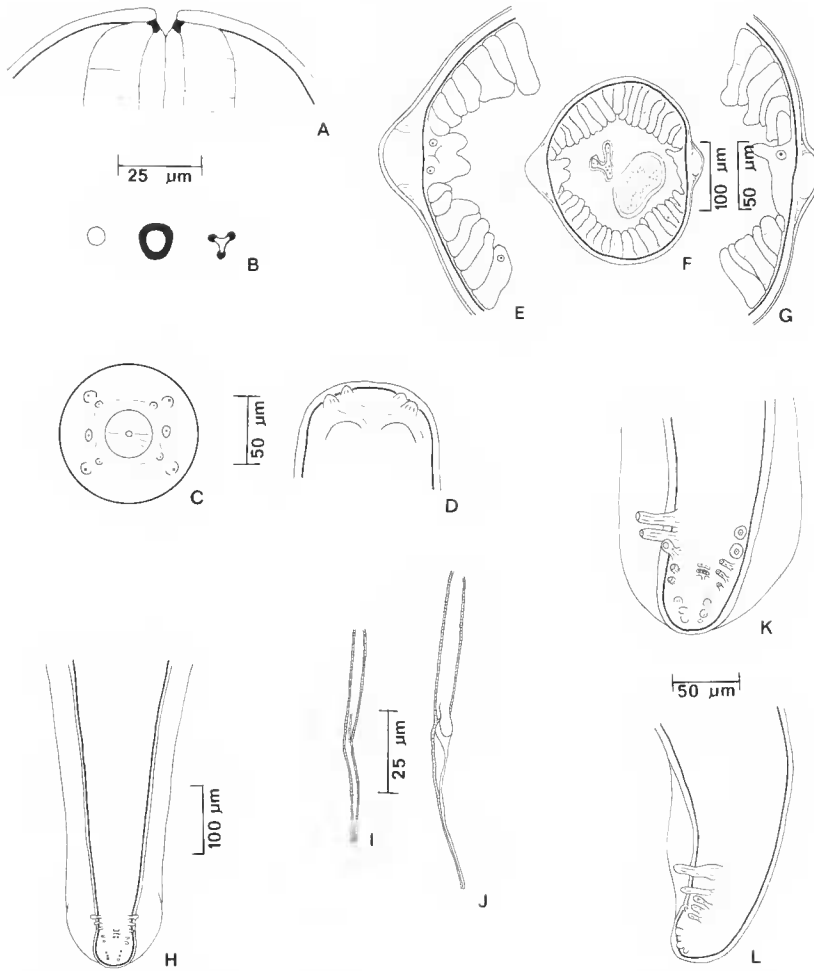


FIG. 7. — *Pelecitus anhingae* Vuylsteke, 1957. ♂ : A, D, cephalic extremity, lateral views at level of oral opening and at cuticular surface ; B, apical views of oral opening at different levels ; C, en face ; E-G, transverse sections of left side, whole body, and right side ; H, posterior end, ventral view ; I, J, spicules, right and left ; K, L, tail, ventral and lateral views.

40 μ m. Nerve ring 160 μ m from anterior extremity. Width of body at nerve ring 125 μ m. Length of muscular œsophagus 360 μ m, glandular œsophagus 580 μ m. Caudal papillae groups as follows : (i) 3 pairs ; (ii) 2 asymmetrical pairs ; (iii) 2 pairs ; (iv) 2 lateral and 2 posterior to anus. Anus from extremity 50 μ m. Left spicule 60 μ m long, right spicule 80 μ m long.

Female : Body in form of loose circular coils or irregularly twisted. Vulva anterior to œsophago-intestinal junction, posteriorly placed on markedly protuberant cone of tissue. Cuticular lips of vulva thin. Vagina directed posteriorly from vulva. Uteri convoluted,

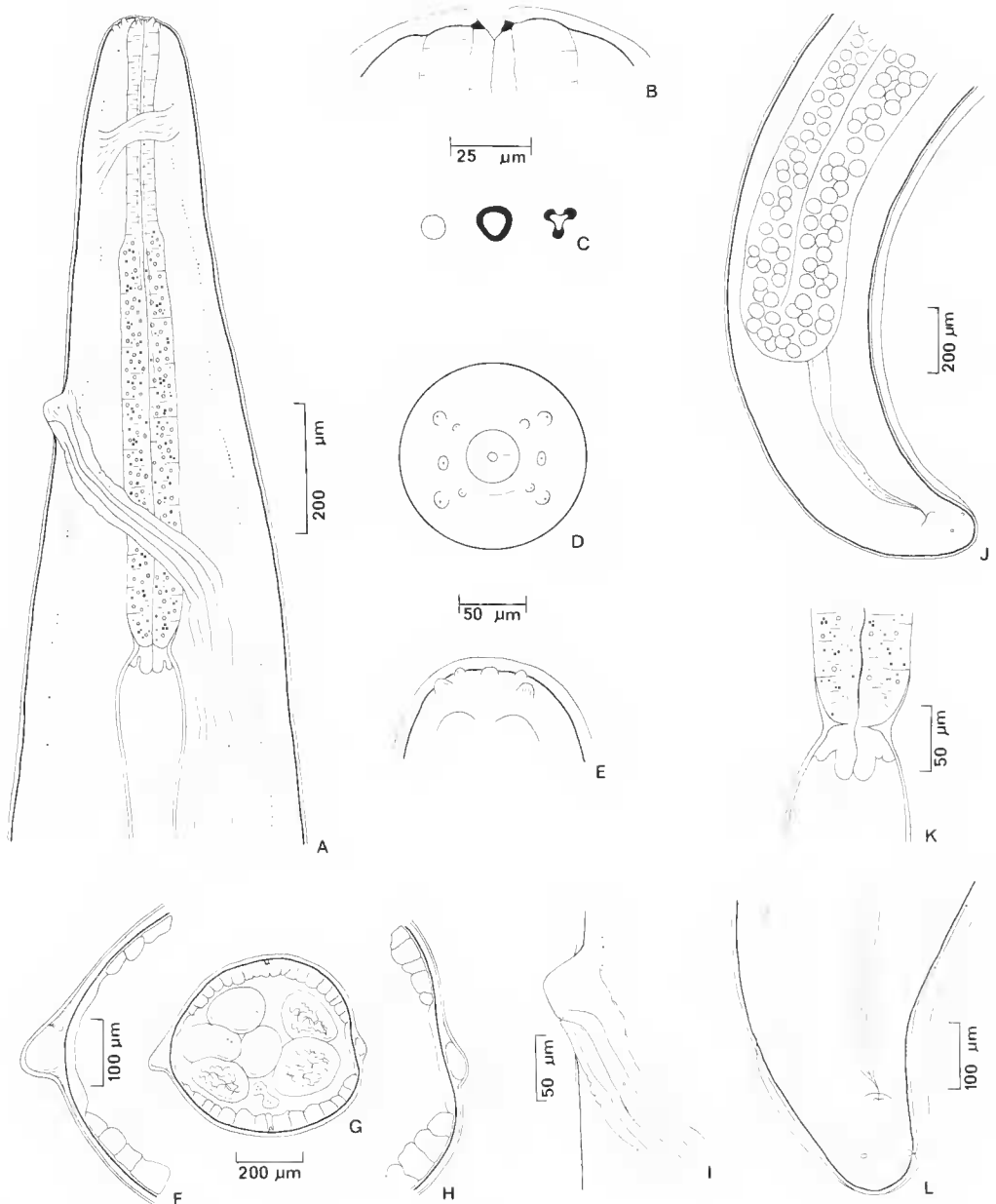


FIG. 8. — *Pelecitus anhingae* Vuylsteke, 1957. ♀: A, anterior end, lateral view ; B, E, cephalic extremity, lateral views at level of oral opening and at cuticular surface ; C, apical views of oral opening at different levels ; D, en face ; F-H, transverse sections of left side, whole body, and right side ; I, vulva ; J, posterior end ; K, oesophago-intestinal junction ; L, tail, sub-lateral view.

portions occasionally present near vulva. Position of ovaries obscured by uteri. Post-deirids not determined. Anus readily apparent.

Allolectotype (female) : Body irregularly twisted. Total length 26 mm. Maximum width (mid body) 500 μm . Transverse striations 6-7 μm wide at mid body. Width of left lateral ala at mid body 60 μm . Nerve ring 180 μm from anterior extremity. Width of body at nerve ring 190 μm . Length of muscular oesophagus 300 μm , glandular oesophagus 620 μm . Vulva 620 μm from anterior extremity. Length of vagina 1.1 mm. Anus 100 μm from caudal extremity. Width of body at anus 150 μm .

Microfilaria (five specimens from anterior vagina) : Loose sheath present. Total length of body 205-215 μm . Extremities bluntly rounded. Maximum width of anterior 3/4 of body 4-5 μm , tapering to 1-2 μm at caudal extremity.

LOCALITY : Type from Garamba National Park, Zaire.

HOST : From VUYLSTEKE (1957), Anhingidae : *Anhinga r. rufa* (Daudin) (type).

SITE IN HOST : See Comments.

COMMENTS

VUYLSTEKE (1957) did not designate a holotype or allotype and we consequently have chosen lectotype (male) and allolectotype (female) specimens from the syntypes.

VUYLSTEKE (1957) incorrectly stated that the species lacked lateral alae. In addition, we found that the spicules were longer than that given by VUYLSTEKE and the cuticular striations were strongly marked.

VUYLSTEKE (1957) reported *P. anhingae* from the "stomach". This is likely incorrect and the specimens were probably found in the legs or feet.

7. *Pelecitus polamaetus* Vuylsteke, 1957

Pelecitus polamaetus Vuylsteke, 1957 : 16-17. — DISSANAIKE, 1967 : 102. — SONIN, 1968 : 365-366. — DISSANAIKE and FERNANDO, 1974 : 201-202.

SPECIMENS : 1) Types (including lectotype, allolectotype, paralectotypes) : IRSNB n° "stat. 1433 — II/fd/17 — 17.X.1951". 2) BM n° 1967.409-411 (listed as *Pelecitus* sp.), ex. *Buteo buteo* in South Africa, collected by R. LIVERSIDGE.

REDESCRIPTION (based on type specimens ; fig. 9, tables 1, 2)

General : Body regularly or irregularly twisted. Body width uniform over most of length but tapering gradually towards extremities. Lateral alae asymmetrical, left larger than right. Cuticle thin, with strong transverse striations and appearing transversely ridged due to every third, fourth, or fifth striation being more prominent than others. Amphids and cephalic papillae markedly protuberant. Pre-oesophageal ring not determined. Oesophagus distinctly divided.

Male : Body irregularly twisted or in form of loose dextral spiral ; if spiralled 1-2 rotations present, outer diameter of spiral approximately 2 mm. Transverse cuticular striations closely spaced. Caudal alae symmetrical. Tail coiled 0.5 turn. Four groups of caudal papillae present as follows : (i) 3 large pedunculate pre-anal pairs extending into alae, symmetrical in arrangement ; (ii) smaller pedunculate ad- to post-anal papillae extending into alae, 2-4 on each side, symmetrical or asymmetrical in arrangement ; (iii) 2 pairs of small sessile papillae near extremity, symmetrical or asymmetrical in arrangement ; (iv) small, sessile peri-anal papillae, 0-1 anterior to anus, 2 posterior to anus. Hyaline and granular inclusions present in caudal alae. Spicules delicate, unequal, dissimilar. Post-deirids 0.2-0.4 mm from caudal extremity, one slightly anterior to other.

Lectotype (male) : Body in form of spiral. Total length 8 mm. Maximum width (mid body) 290 μ m. Transverse striations 2 μ m wide and ridges 6-7 μ m apart at mid body. Width of left lateral ala at mid body 45 μ m. Nerve ring 150 μ m from anterior extremity. Width of body at nerve ring 125 μ m. Length of muscular oesophagus 270 μ m, glandular oesophagus 550 μ m. Caudal papillae groups as follows : (i) 3 pairs ; (ii) 2 symmetrical pairs ; (iii) 2 pairs ; (iv) 2 posterior to anus. Anus 50 μ m from caudal extremity. Left spicule 130 μ m long, right spicule 80 μ m long.

Female : Body irregularly twisted or in form of loose dextral helix ; if helical 2 rotations present, outer diameter of helix approximately 3 mm. Transverse cuticular striations widely spaced. Vulva located anterior to oesophago-intestinal junction, posteriorly placed on markedly protuberant cone of tissue. Cuticular lips of vulva thin. Vagina directed posteriorly from vulva. Uteri convoluted, portions occasionally near vulva. One ovary present in anterior quarter of body, other in posterior quarter. Post-deirids not determined.

Allolectotype (female) : Body irregularly twisted. Total length 18 mm. Maximum width (mid body) 620 μ m. Transverse striations 5-6 μ m wide and ridges 20 μ m apart at mid body. Width of left lateral ala at mid body 125 μ m. Nerve ring 180 μ m from anterior extremity. Width of body at nerve ring 140 μ m. Length of muscular oesophagus 300 μ m, glandular oesophagus 600 μ m. Vulva 500 μ m from anterior extremity. Length of vagina not determined. Anus 75 μ m from caudal extremity. Width of body at anus 150 μ m.

LOCALITY : Type from Garamba National Park, Zaire. Others from South Africa.

HOSTS : From VUYLSTEKE (1957), Accipitridae : *Polemaetus bellicosus* (Daudin). BM specimens : Accipitridae : *Buteo buteo* (L.).

SITE IN HOST : Not given in VUYLSTEKE (1957), listed as " foot pads " in information accompanying BM specimens.

COMMENTS

VUYLSTEKE (1957) did not designate a holotype or allotype and we consequently have chosen lectotype (male) and allolectotype (female) specimens from the syntype series. The material is not in good condition.

See Comments under *P. fulicaeatrae* with regard to reports from Falconiformes.

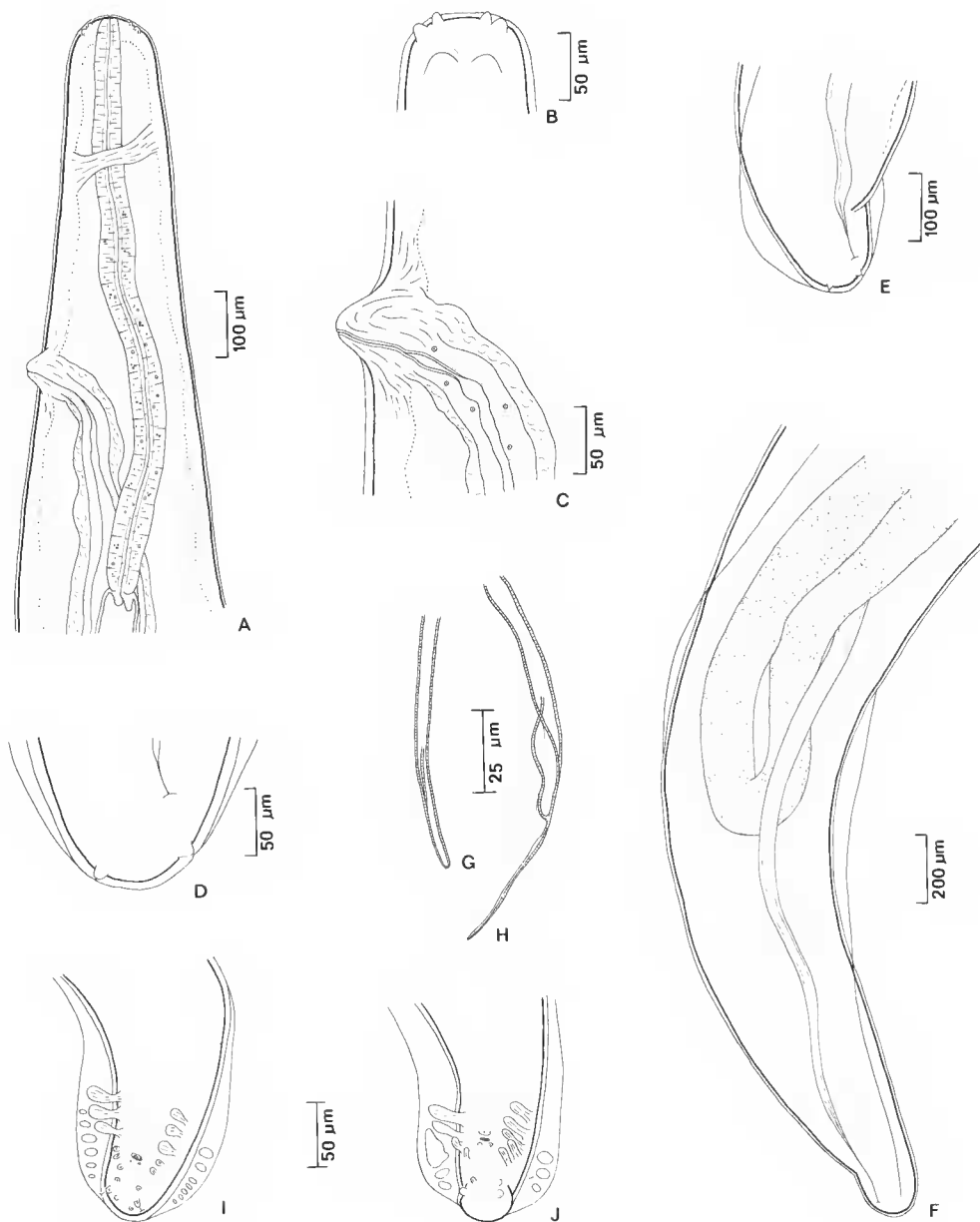


FIG. 9. — *Pelecitus polamaetus* Vuylsteke, 1957, A, C-F, ♀ ; B, G-J, ♂ : A, anterior end, lateral view ; B, cephalic extremity ; lateral view at level of cuticular surface ; C, vulva ; D, E, tail, sub-lateral views ; F, posterior end ; G, H, spicules, right and left ; I, J, tail, ventral views.

8. *Pelecitus ceylonensis* Dissanaïke, 1967

Pelecitus ceylonensis Dissanaïke, 1967 : 96-104, pl. 1.

SPECIMENS : Types in a collection at the Department of Parasitology, Faculty of Medicine, University of Ceylon, Colombo, Ceylon (Sri Lanka). We were unable to borrow them.

LOCALITY : Type from Colombo, Sri Lanka.

HOSTS : From DISSANAÏKE (1967), Columbidae : " ash dove " (type) ; Phasianidae : " chicken " ; Corvidae : " crow ".

SITE IN HOST : Among tendons and muscles of legs.

COMMENTS

Adult worms were first found in ash-doves experimentally infected with third-stage larvae from wild-caught mosquitoes (*Mansonia crassipes*). Adult worms were subsequently found in wild crows (species not stated) in the same locality and microfilariae were found in experimentally infected chickens.

9. *Pelecitus galli* Dissanaïke and Fernando, 1974

Pelecitus galli Dissanaïke and Fernando, 1974 : 199-203.

SPECIMENS : Types (including holotype, allotype, paratypes) : BM n° 1975.164-171.

REDESCRIPTION (based on holotype and paratypes ; fig. 10, tables 1, 2)

General : Body in form of loose circular coils or loose dextral spiral. Cuticle thick, with strong transverse striations. Lateral alae asymmetrical, left larger than right. Amphids not salient. Cephalic papillae not markedly protuberant but causing obvious depression in adjacent cuticle. Pre-oesophageal ring present, delicate. Oesophagus not externally divided.

Male : Caudal alae asymmetrical. Tail coiled 0.5-1 turn. Two groups of caudal papillae present as follows : (i) pedunculate pre- to post-anal papillae extending into alae, 4-5 on each side, symmetrical or asymmetrical in arrangement, variable in size but anterior-most largest ; (ii) 2-3 small, sessile to semi-pedunculate papillae immediately posterior to anus. Inclusions not observed within caudal alae. Spicules stout, subequal, dissimilar. Post-deirids 0.5-1.0 mm from caudal extremity, one slightly anterior to other.

Female : Vulva anterior to oesophago-intestinal junction, centrally placed on slightly protuberant cone. Cone formed by thick cuticular lips of vulva and slight elevation of adjacent tissue. Vagina directed posteriorly from vulva, convoluted. Uteri convoluted. One ovary present in anterior quarter of body, other in posterior third. Anus visible as

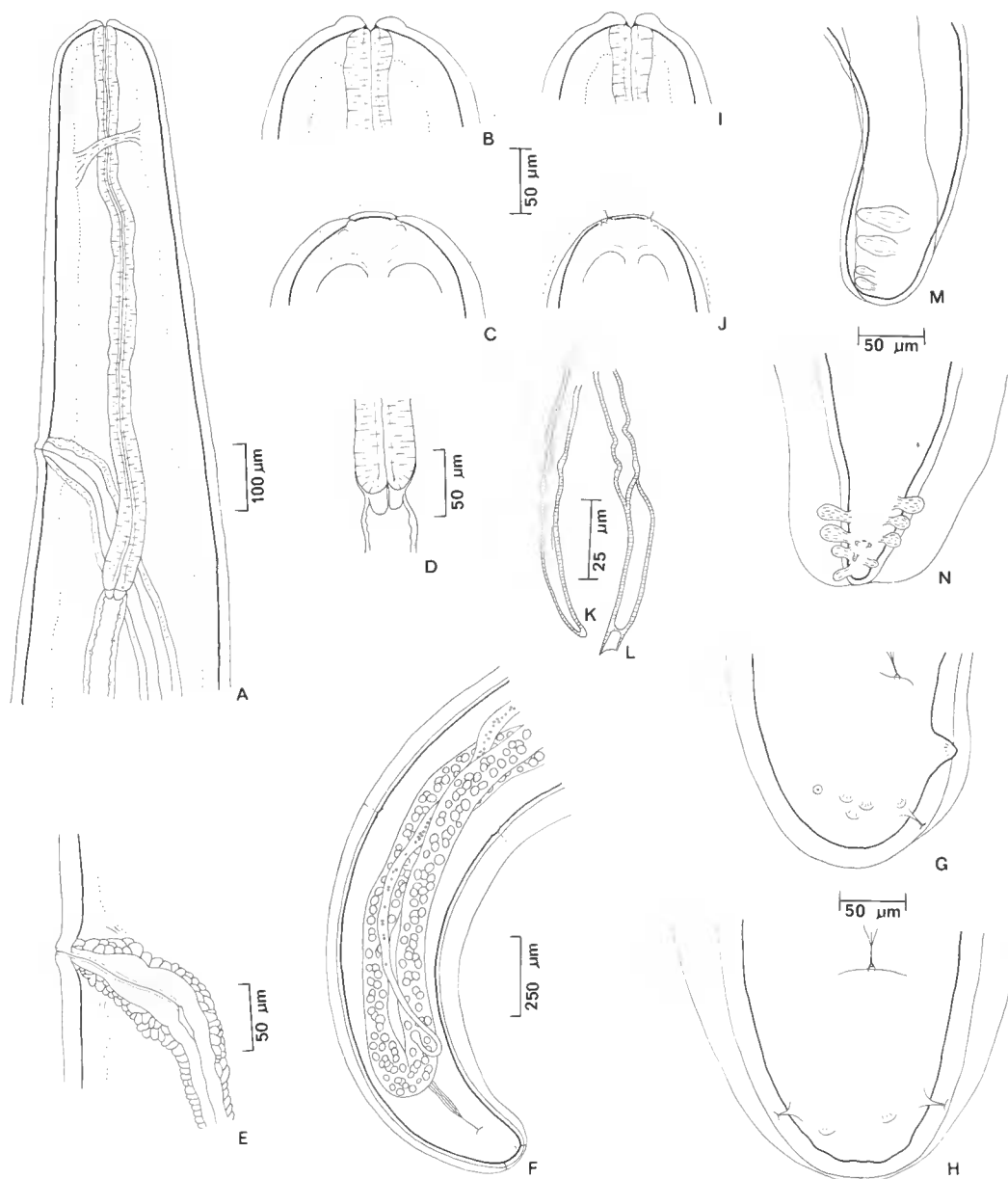


FIG. 10. — *Pelecitus galli* Dissanaïke & Fernando, 1974. A-H, ♀; I-N, ♂ : A, anterior end, lateral view ; B, C, cephalic extremity, lateral views at level of oral opening and at cuticular surface ; D, oesophago-intestinal junction ; E, vulva ; F, posterior end ; G, H, tail, sub-lateral and ventral views, I, J, cephalic extremity, lateral view at level of oral opening and at cuticular surface ; K, L, spicules, right and left ; M, N, tail, lateral and ventral views.

delicate slit. Post-deirids 1.2-1.3 mm from caudal extremity, one slightly anterior to other. Small to large sessile papillae present on caudal extremity.

LOCALITY : Type from Tasek Bera, Pahang State, Malaysia.

HOST : From DISSANAIKE and FERNANDO (1974), Phasianidae : *Gallus gallus spadiceus*.

SITE IN HOST : Among tendons at base of legs.

COMMENTS : DISSANAIKE and FERNANDO (1974) described the microfilaria. See Comments under *P. barusi*.

10. *Pelecitus barusi* Coy Otero, 1982

Pelecitus barusi Coy Otero, 1982 : 1-6.

SPECIMENS : Types in the Coleccion CEZACC, del Instituto de Zoologia de la Academia de Ciencias de Cuba. We were unable to borrow them.

LOCALITY : Type from Alonso de Rojas, Consolacion del Sur, Provincia Pinar del Rio, Cuba.

HOST : From COY OTERO (1982), Columbidae : *Zenaida m. macroura* (L.) (type).

SITE IN HOST : Feet.

COMMENTS

COY OTERO (1982) also reported one case of *P. barusi* from " the breast " of the host. This requires confirmation as the location is unusual for a species of *Pelecitus* but is typical for *Eulimdana clava* (Wedl, 1856), a cosmopolitan parasite of pigeons (BARTLETT *et al.*, 1985).

Pelecitus barusi and *P. galli* appear morphologically similar. However, because the description of *P. barusi* lacks details and because specimens were not available to us for examination, we leave the clarification of their relationship to future workers.

11. *Pelecitus tubercauda* Vanderburgh, Anderson and Stock, 1984

Pelecitus tubercauda Vanderburgh, Anderson and Stock, 1984 : 362-367.

SPECIMENS : 1) Holotype and allotype : USNM n^{os} 77834 and 77835. 2) Paratypes : USNM n^o 77836.

REDESCRIPTION (based on paratypes ; fig. 11, tables 1, 2)

General : Body regularly twisted. Body width uniform over mid region but tapering gradually towards both ends ; width uniform from nerve ring to cephalic extremity. Lateral alae asymmetrical, left larger than right. Cuticle thick, with fine transverse

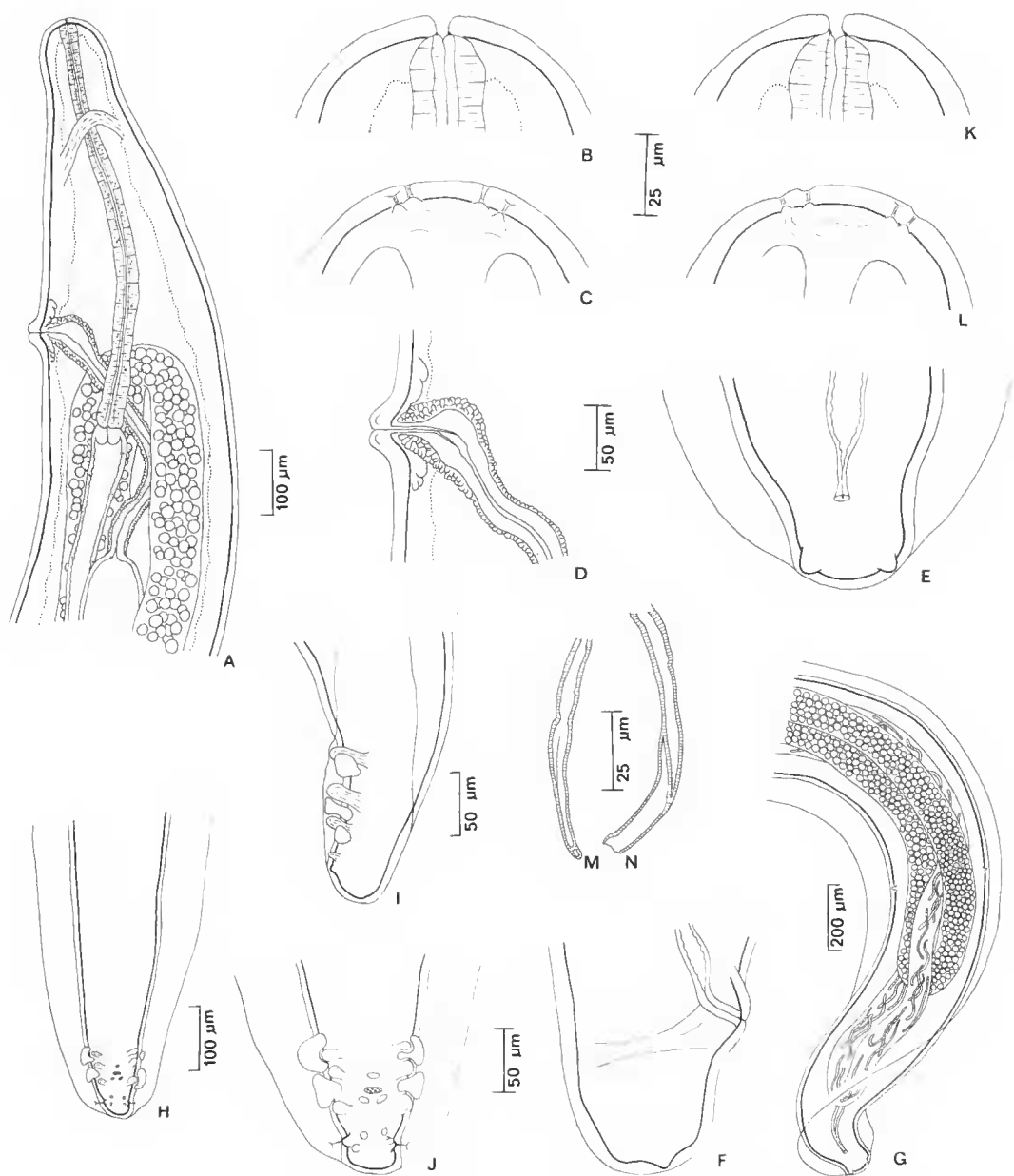


FIG. 11. — *Pelecitus tubercauda* Vanderburgh, Anderson & Stock, 1984. A-G, ♀; H-N, ♂ : A, anterior end, lateral view ; B, C, cephalic extremity, lateral views at level of oral opening and at cuticular surface ; D, vulva ; E, F, tail, ventral and lateral views ; G, posterior end, ventral view ; H, posterior end, ventral view ; I, J, tail, lateral and ventral views ; K, L, cephalic extremity, lateral views at level of oral opening and at cuticular surface ; M, N, spicules, right and left.

striations. Amphids not salient. Cephalic papillae not markedly protuberant. Pre-oesophageal ring present, delicate. Œsophagus inconspicuously divided.

Male : Body in form of dextral spiral or helix, 2-3 rotations present, outer diameter of helix approximately 1 mm. Caudal alae symmetrical. Tail coiled 0.5-1 turn. Three groups of caudal papillae present as follows : (i) pedunculate pre- to post-anal papillae extending into alae, 3-4 on each side, symmetrical or asymmetrical in arrangement, variable in size ; (ii) 1-2 smaller sessile to semi-pedunculate subterminal pairs ; (iii) small, sessile peri-anal papillae, 0-1 anterior and 2 posterior to anus. Granular inclusions present within caudal alae. Spicules stout, equal, dissimilar. Post-deirids 0.4-0.7 mm from caudal extremity, one slightly anterior to other.

Female : Body in form of tight dextral helix, 2-3 rotations present, outer diameter of helix approximately 1-1.5 mm. Vulva anterior to oesophago-intestinal junction, centrally placed on markedly protuberant cone. Cone formed by thick cuticular lips of vulva and slight elevation of underlying tissue. Oval cells present immediately below vulva. Vagina directed posteriorly from vulva. Uteri convoluted, portions frequently present near vulva. Position of ovaries obscured by uteri. Anus on slight elevation. Post-deirids 1.0-1.2 mm from caudal extremity, one slightly anterior to other.

LOCALITY : Type from Wellington County, Ontario, Canada.

HOST : From VANDERBURGH *et al.* (1984), Parulidae : *Geothlypis trichas* (L.).

SITE IN HOST : Between muscles and around tendons of knee region.

COMMENTS : The “ longitudinal striations ” of VANDERBURGH *et al.* (1984) are the outlines of the longitudinal muscles. VANDERBURGH *et al.* (1984) described the microfilaria.

12. *Pelecitus andersoni* n. sp.

SPECIMENS : 1) Types : material given to us by Dr. BRADLEY, MNHN n^{os} 46 DL (holotype), 47 DL (allotype), 48 DL (paratypes), ex. unidentified species of “ macaw ” imported into USA from Central or South America. 2) Material given to us by Dr. GREVE, MNHN n^o 49 DL, ex. *Ara macao* imported into USA from South America. 3) Material given to us by Dr. GREVE, MNHN n^o 50 DL, ex. *Pionites l. leucogaster* imported into USA from South America.

DESCRIPTION (based on types ; figs. 12, 13, 17 ; tables 1, 2)

General : Body irregularly twisted or in form of loose dextral spiral. Body width uniform over most of length but tapering gradually at both ends ; width from nerve ring to cephalic extremity uniform or decreasing slightly. Lateral alae asymmetrical, left larger than right. Cuticle thick, with strong transverse striations. Amphids not salient. Cephalic papillae not markedly protuberant. Pre-oesophageal ring present, delicate. Œsophagus distinctly divided.

Male : If body spiralled, 1-1.5 rotations present, outer diameter of spiral approximately 1-2 mm. Caudal alae symmetrical. Tail coiled 0.5-1 turn. Three groups of caudal papil-

lae as follows : (i) pedunculate pre- to post-anal papillae extending into alae, 1-6 on left side, 3-6 on right side, symmetrical or asymmetrical in arrangement, variable in size ; (ii) 0-2 pairs of subterminal papillae, single or double, variable in size ; (iii) small, sessile peri-anal papillae, 1 anterior and 2 posterior to anus. Granular inclusions present within caudal alae. Spicules stout, unequal, dissimilar. Post-deirids 0.2-0.6 mm from caudal extremity, one slightly anterior to other.

Holotype (male) : Body irregularly twisted. Total length 11 mm. Maximum width (mid body) 460 μ m. Transverse striations 5 μ m wide at mid body. Width of left lateral

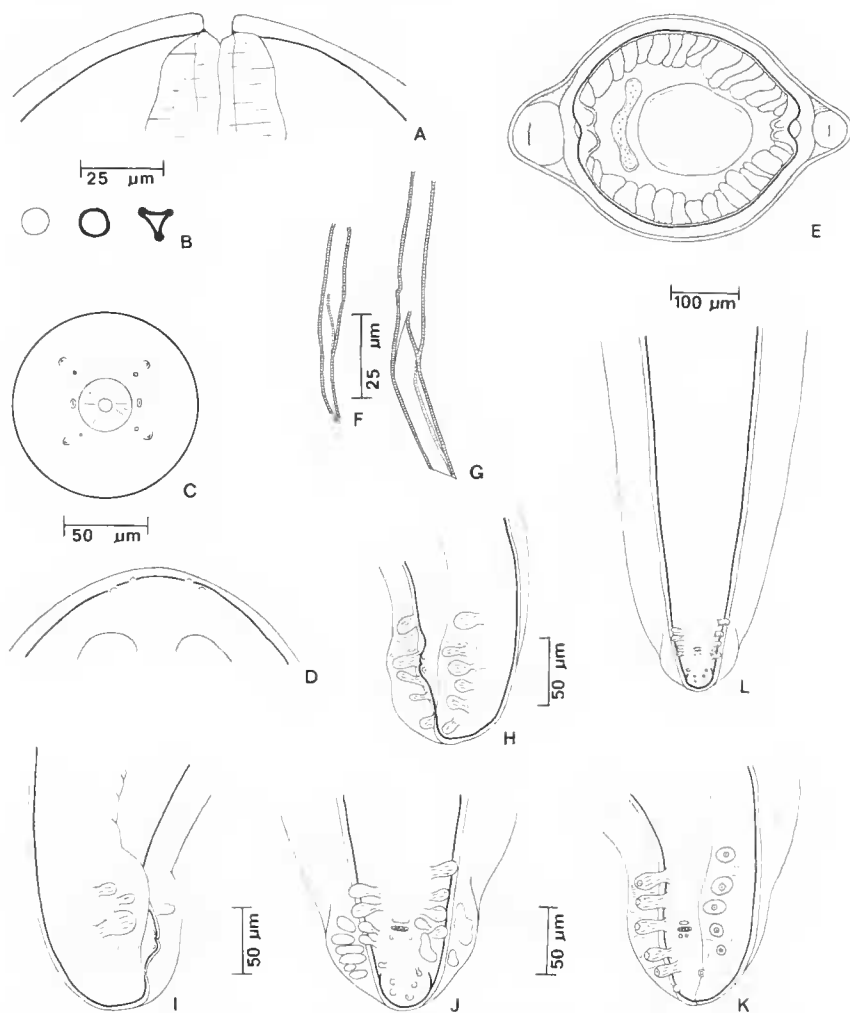


FIG. 12. — *Pelecitus andersoni* n. sp. ♂ : A, D, cephalic extremity, lateral views at level of oral opening and at cuticular surface ; B, apical views of oral opening at different levels ; C, en face ; E, transverse section of body ; F, G, spicules, right and left ; H-K, tail, sub-lateral and ventral views ; L, posterior end, ventral view.

ala at mid body 90 μm . Nerve ring 150 μm from anterior extremity. Width of body at nerve ring 150 μm . Length of muscular oesophagus 280 μm , glandular oesophagus 500 μm . Caudal papillae as follows : (i) 5 on left side, 5 on right side, asymmetrical ; (ii) 2 double pairs ; (iii) 1 anterior and 2 posterior to anus. Anus 50 μm from caudal extremity. Left spicule 88 μm long, right spicule 60 μm long.

Female : If body spiralled, 2-3 rotations present, outer diameter of spiral approximately 3 mm. Vulva anterior to oesophago-intestinal junction, slightly or not protuberant although centrally placed on cone of tissue extending slightly into cuticle of body wall. Cuticular lips of vulva thick. Tear-drop shaped cells present adjacent to vulva. Vagina directed posteriorly from vulva, convoluted, occasionally looping anteriorly to pass vulva. Uteri convoluted, portions frequently present near vulva. One ovary present in anterior half of body, other in posterior third. Post-deirids 1-2 mm from caudal extremity, one slightly anterior to other. Anus readily apparent. Caudal extremity with slight constriction.

Allotype (female) : Body in form of loose spiral. Total length 15 mm. Maximum width (mid body) 660 μm . Transverse cuticular striations 7-8 μm wide at mid body. Width of left lateral ala at mid body 120 μm . Nerve ring 200 μm from anterior extremity. Width of body at nerve ring 215 μm . Length of muscular oesophagus 435 μm , glandular oesophagus 500 μm . Vulva 760 μm from anterior extremity. Length of vagina 1.5 mm. Anus 150 μm from caudal extremity. Width of body at anus 230 μm .

Microfilaria (five specimens from anterior vagina) : Loose sheath present. Total length of body 180-210 μm . Extremities bluntly rounded. Maximum width of anterior 4/5 of body 5-6 μm , tapering to 2-3 μm at caudal extremity.

LOCALITY : Type from " Central or South America " (see Comments).

HOSTS : Psittacidae : " macaw ", unidentified species (type), *Ara macao* (L.), *Pionites l. leucogaster* Kuhl.

SITE IN HOST : Among tendons of feet.

COMMENTS

Pelecitus andersoni n. sp. is distinguished from other species of *Pelecitus* as follows : the body of *P. andersoni* is twisted (cf. *P. circularis*, *P. roemeri* n. comb., *P. tercostatus*) but not in a tight helix (cf. *P. helycinus*, *P. tubercauda*). The caudal alae are broad (cf. *P. armenica*, *P. chabaudi* n. sp.) and the papillae extending into the alae are extremely variable in number, size, and arrangement and the spicules are stout (cf. *P. fulicaeatrae*, *P. anhingae*, *P. polamaetus*, *P. vuylstekae* nom. nov.). The lateral alae are broad (cf. *P. scapiceps* n. comb.) and the oesophagus is distinctly divided (cf. *P. galli*, *P. ceylonensis*, *P. barusi*).

Specimens of *P. andersoni* were obtained from psittacids imported into the USA. " Macaws " are native to Central and South America, *A. macao* occurs from southcentral Mexico to Bolivia and Brazil, and *P. l. leucogaster* in northern Brazil (HOWARD and MOORE, 1984).

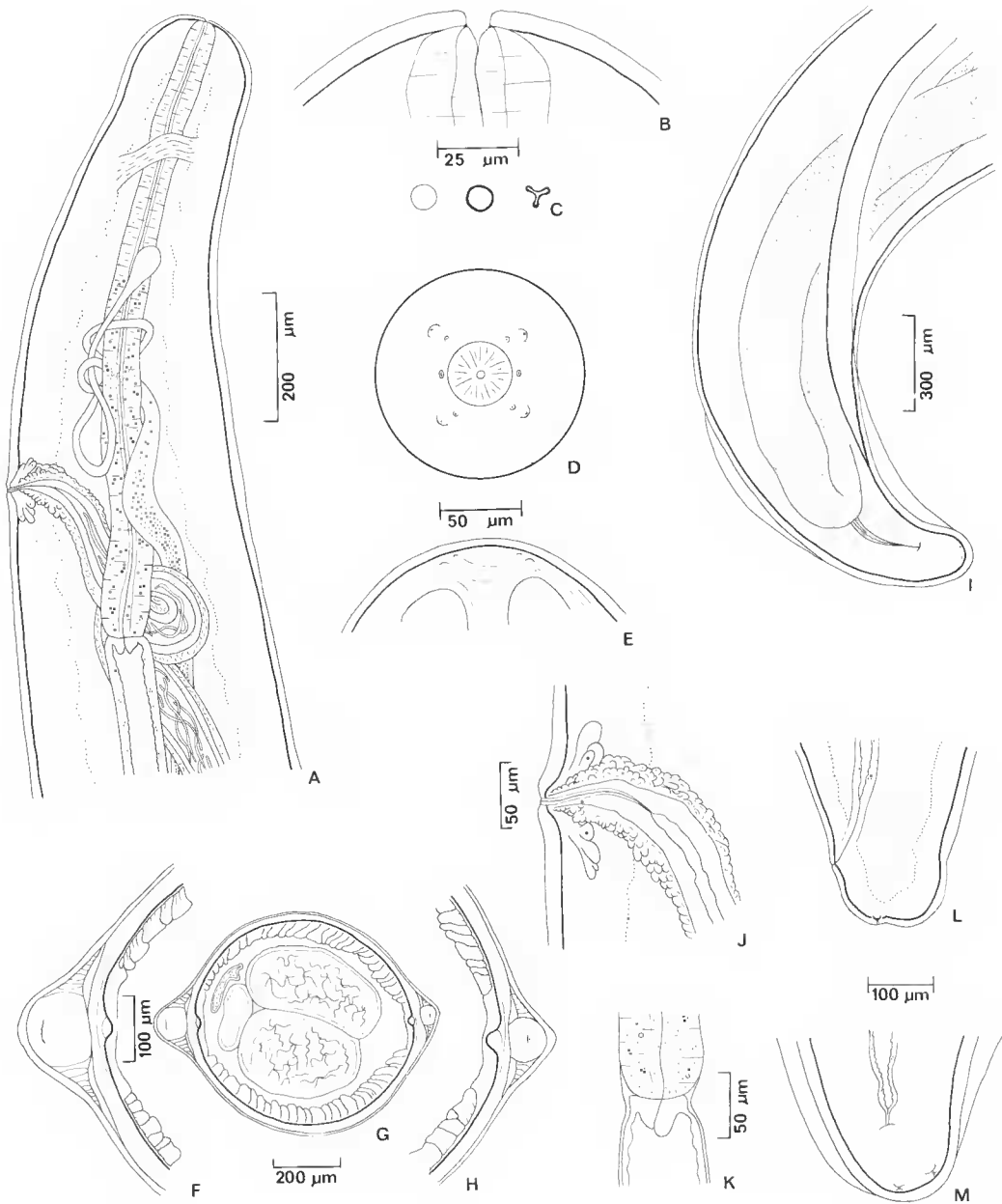


FIG. 13. — *Pelecitus andersoni* n. sp. ♀ : A, anterior end, lateral view ; B, E, cephalic extremity, lateral view at level of oral opening and at cuticular surface ; C, apical views of oral opening at different levels ; D, en face ; F-H, transverse sections of left side, whole body, and right side ; I, posterior end ; J, vulva ; K, oesophago-intestinal junction ; L, M, tail, lateral and ventral views.

13. *Pelecitus chabaudi* n. sp.

SPECIMENS : Types (including holotype, allotype, paratypes) : ZMB n° 6600 (originally catalogued as *P. falconis*), ex. *Pernis apivorus* at Schwyz, Berner Oberland, Switzerland, collected by B. HORNING, 9 June 1965.

DESCRIPTION (based on types ; figs. 14, 17, tables 1, 2)

General : Body irregularly curved or in 0.5-1.5 circular coils, but not twisted. Body width uniform over most of length, tapering gradually towards anterior end and either with slight constriction near nerve ring or of uniform width from nerve ring to cephalic extremity, tapering slightly towards abruptly rounded posterior extremity. Cuticle thin, with strong transverse striations. Lateral alae symmetrical. Amphids not salient. Cephalic papillae not markedly protuberant. Pre-oesophageal ring present and delicate, or absent. Oesophagus not externally divided.

Male : Caudal alae symmetrical. Tail coiled 0.5 turn. Three groups of caudal papillae present as follows : (i) pre- to post-anal papillae extending into alae, 2-4 on each side, symmetrical or asymmetrical in arrangement, anteriormost largest ; (ii) 2 small, sessile subterminal papillae ; (iii) peri-anal papillae, 1 anterior and 2 posterior to anus. Inclusions not observed within caudal alae. Spicules stout, subequal, dissimilar. Post-deirids 0.3-0.5 mm from caudal extremity, one slightly anterior to other.

Holotype (male) : Body irregularly curved. Total length 6 mm. Maximum width 350 μ m. Transverse striations 4 μ m wide at mid body. Width of left lateral ala at mid body 27 μ m. Nerve ring 150 μ m from anterior extremity. Width of body at nerve ring 110 μ m. Length of muscular oesophagus 230 μ m, glandular oesophagus 480 μ m. Caudal papillae as follows : (i) 3 on left side, 4 on right ; (ii) 2 ; (iii) 1 anterior and 2 posterior. Anus 45 μ m from caudal extremity. Left spicule 70 μ m long, right spicule 65 μ m long.

Female : Vulva at, anterior, or posterior to oesophago-intestinal junction, centrally placed on slightly protuberant cone of tissue. Cuticular lips of vulva thin. Vagina directed posteriorly from vulva, occasionally looping anteriorly to pass vulva. Uteri convoluted, portions frequently present near vulva. One ovary present in anterior half of body, other in posterior third. Post-deirids 2.0-2.5 mm from caudal extremity. Anus visible as delicate opening.

Allotype (female) : Body in form of half circular coil. Total length 13 mm. Maximum width (mid body) 540 μ m. Transverse cuticular striations 5 μ m wide at mid body. Width of left lateral ala at mid body 20 μ m. Nerve ring 150 μ m from anterior extremity. Width of body at nerve ring 140 μ m. Length of muscular oesophagus 230 μ m, glandular oesophagus 400 μ m. Vulva 800 μ m from anterior extremity. Length of vagina 1.3 mm. Anus 110 μ m from caudal extremity. Width of body at anus 210 μ m.

Microfilaria (five specimens from anterior vagina) : Loose sheath present. Total length of body 205-235 μ m. Extremities bluntly rounded. Maximum width of anterior 4/5 of body 4.5 μ m, tapering to 2 μ m at caudal extremity.

LOCALITY : Type from Schwyz, Berner Oberland, Switzerland.

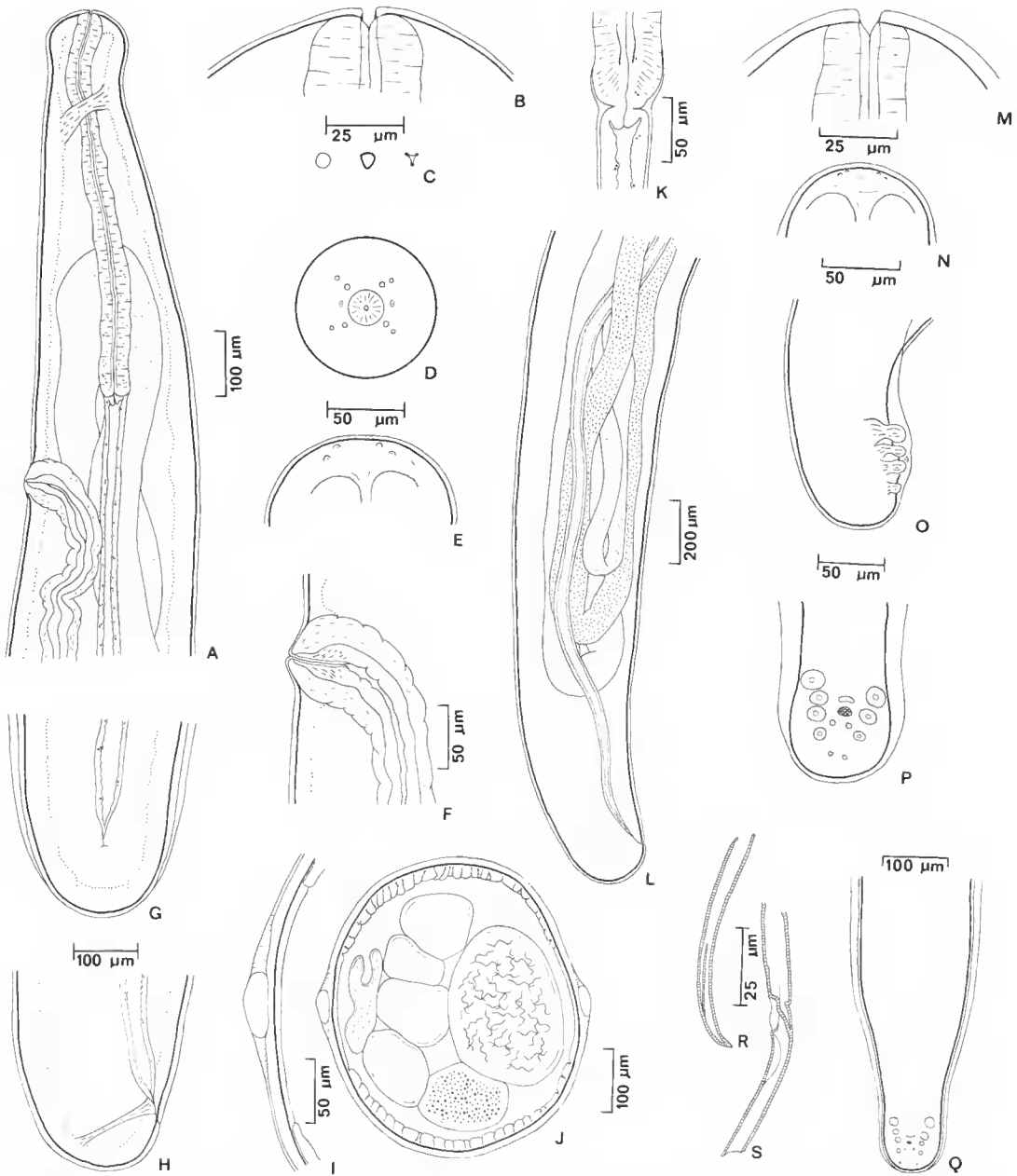


FIG. 14. — *Pelecitus chabaudi* n. sp. A-L, ♀; M-Q, ♂ : A, anterior end, lateral view ; B, E, cephalic extremity, lateral views at level of oral opening and at cuticular surface ; C, apical views of oral opening at different levels ; D, en face ; F, vulva ; G, H, tail, ventral and lateral views ; I, J, transverse sections of left side and whole body ; K, oesophago-intestinal junction ; L, posterior end ; M, N, cephalic extremity, lateral views at level of oral opening and at cuticular surface ; O, P, tail, lateral and ventral views ; R, S, spicules, right and left ; Q, posterior end, ventral view.

HOST : Accipitridae : *Pernis apivorus* (L.) (type).

SITE IN HOST : Around tendons of feet.

COMMENTS

Pelecitus chabaudi n. sp. is readily distinguished from *P. armenica* by its smaller spicules and from all other species of *Pelecitus* by its narrow lateral and caudal alae.

See also Comments under *P. fulicaeatrae* with regard to reports from Falconiformes.

14. *Pelecitus vuylstekae* nom. nov.

Pelecitus ardeae Vuylsteke not *P. ardeae* (Molin) : VUYLSTEKE, 1957 : 17. — SONIN, 1968 : 355.
Pelecitus fulicaeatrae (Diesing) : in part BARUS *et al.*, 1978 : 245-246.

SPECIMENS : Types (including lectotype, allolectotype, paralectotypes) : IRSNB n° “ stat. 1304 — 11/fc/15 — 29.IX.1951 ”.

REDESCRIPTION (based on types, figs. 15, 16, 17, tables 1, 2)

General : Body in loose circular coils or in form of loose dextral spiral. Body width uniform over most of length but tapering gradually at both ends. Lateral alae asymmetrical ; left larger than right. Cuticle thin, with strong transverse striations. Amphids and cephalic papillae markedly protuberant. Pre-oesophageal ring present, readily apparent. Oesophagus divided ; distinctness of division showing sexual dimorphism.

Male : If body spiralled, 1.5 rotations present, outer diameter of spiral approximately 2 mm. Oesophagus distinctly divided, glandular portion in some specimens with numerous abnormal bulges. Caudal alae symmetrical. Tail coiled 0.5-1 turn. Four groups of caudal papillae present as follows : (i) 3 large, pedunculate pre-anal pairs extending into alae, symmetrical in arrangement ; (ii) smaller, pedunculate ad- to post-anal papillae extending into alae, 2-4 on each side, symmetrical or asymmetrical in arrangement ; (iii) 2 pairs of sessile papillae between previous group and caudal extremity, symmetrical in arrangement, variable in size ; (iv) small, sessile peri-anal papillae, 0-2 lateral or slightly anterior to anus, 2 immediately posterior to anus. Hyaline inclusions occasionally present within caudal alae. Spicules delicate, unequal, dissimilar. Post-deirids 0.1-0.4 mm from caudal extremity, one slightly anterior to other.

Lectotype (male) : Body in form of spiral. Total length 8 mm. Maximum width (mid body) 350 μ m. Transverse striations 3-4 μ m wide at mid body. Width of left lateral ala at mid body 45 μ m. Nerve ring 170 μ m from anterior extremity. Width of body at nerve ring 140 μ m. Length of muscular oesophagus 340 μ m, glandular oesophagus 650 μ m. Caudal papillae as follows : (i) 3 pairs ; (ii) 2 symmetrical pairs ; (iii) 2 pairs ; (iv) 2 lateral and 2 posterior to anus. Anus 50 μ m from caudal extremity. Left spicule 80 μ m long, right spicule 65 μ m long.

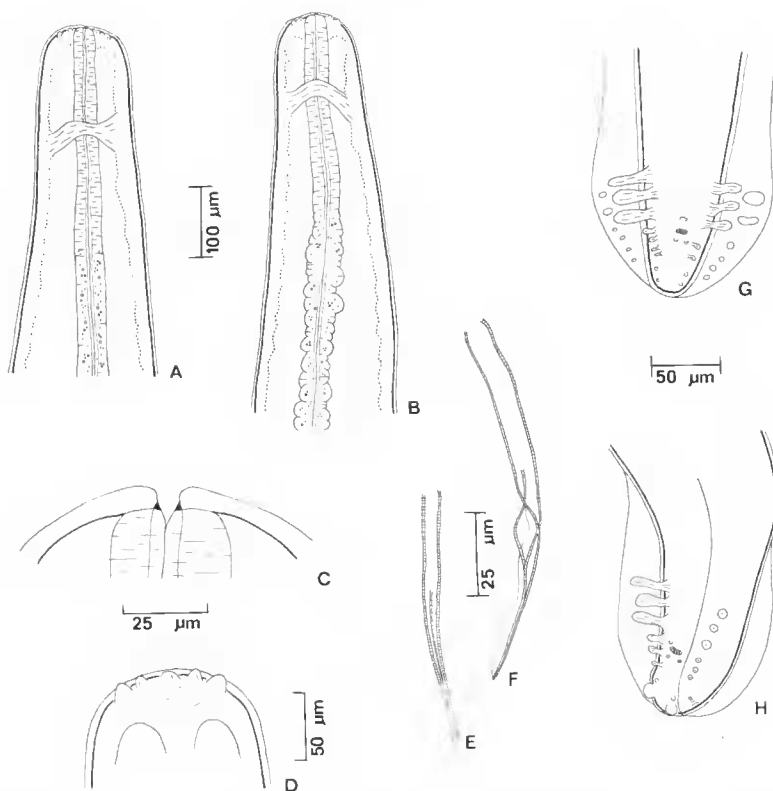


FIG. 15. — *Pelecitus vuylstekae* nom. nov. ♂ : A, anterior end, lateral view, normal oesophagus ; B, anterior end, lateral view, abnormal oesophagus ; C, D, cephalic extremity, lateral views at level of oral opening and at cuticular surface ; E, F, spicules, right and left ; G, H, tail, ventral and sub-lateral views.

Female : If body spiralled, 2-3 rotations present, outer diameter of spiral approximately 3 mm. Oesophagus indistinctly divided. Vulva anterior to oesophago-intestinal junction, posteriorly placed on markedly protuberant cone of muscular tissue. Cuticular lips of vulva thin. Vagina directed posteriorly from vulva. Uteri convoluted, portions occasionally present near vulva. One ovary present in anterior quarter of body, other in posterior quarter. Post-deirids 0.5-1.0 mm from caudal extremity, one slightly anterior to other. Anus readily apparent.

Allolectotype (female) : Body in 1.5 circular coils. Total length 18 mm. Maximum width (mid body) 600 µm. Transverse striations 4-5 µm at mid body. Width of left lateral ala at mid body 50 µm. Nerve ring 180 µm from anterior extremity. Width of body at nerve ring 150 µm. Length of muscular oesophagus 310 µm, glandular oesophagus 750 µm. Vulva 550 µm from anterior extremity. Length of vagina 1.7 mm. Anus 140 µm from caudal extremity. Width of body at anus 150 µm.

Microfilaria (five specimens from anterior vagina) : Loose sheath present. Total

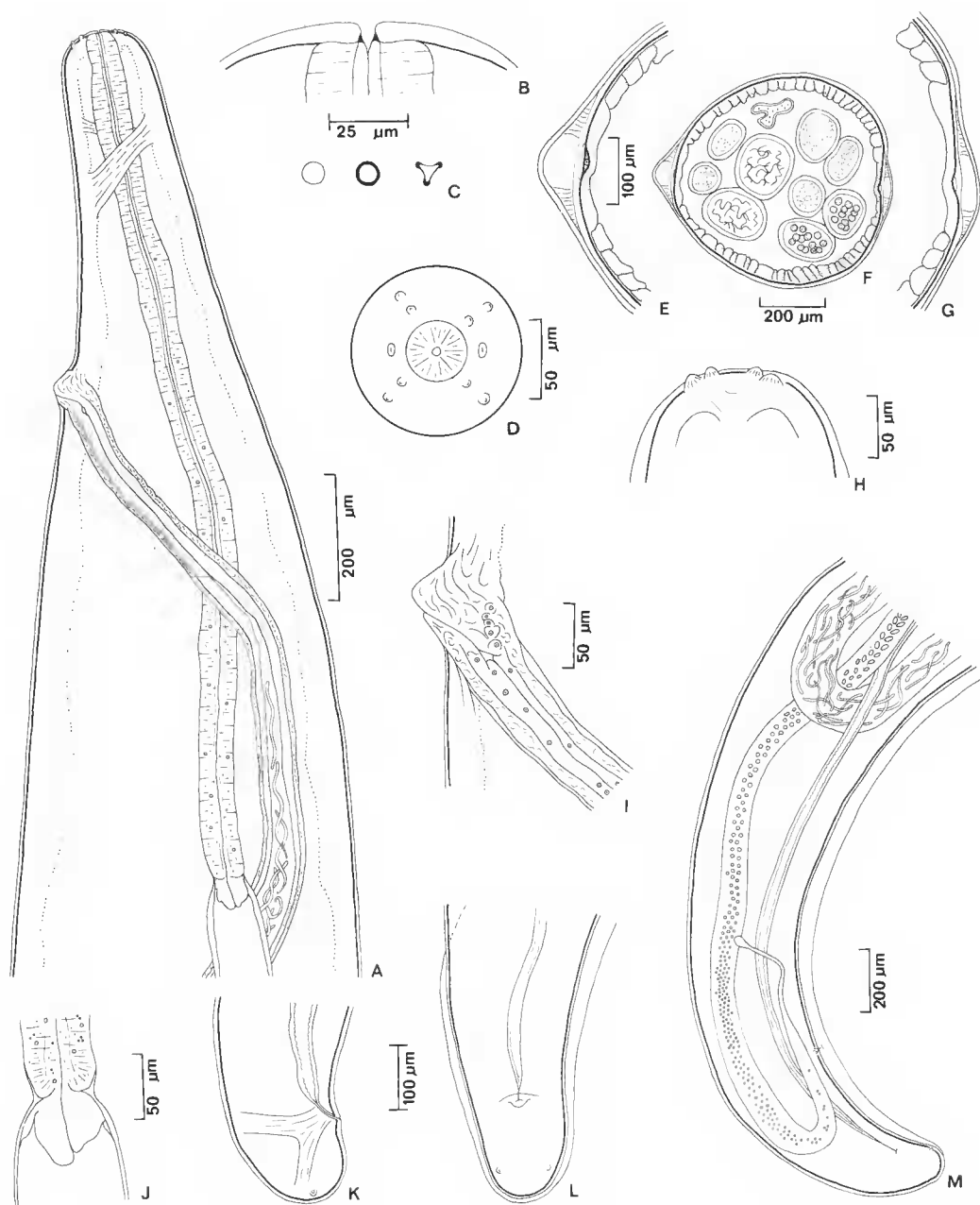


FIG. 16. — *Pelecitus vuylstekae* nom. nov. ♀ : A, anterior end, lateral view ; B, H, cephalic extremity, lateral views at level of oral opening and at cuticular surface ; C, apical view of oral opening at various levels ; D, en face ; E-G, transverse sections of left side, whole body, and right side ; I, vulva ; J, oesophago-intestinal junction ; K, L, tail, lateral and ventral views ; M, posterior end.

length of body 220-250 μm . Extremities bluntly rounded. Maximum width of anterior 3/4 of body 4-5 μm , tapering to 2-3 μm at caudal extremity.

LOCALITY : Type from Garamba National Park, Zaire.

HOST : VUYLSTEKE (1957), Ardeidae : *Ardea goliath* Cretzchmar.

SITE IN HOST : Talon.

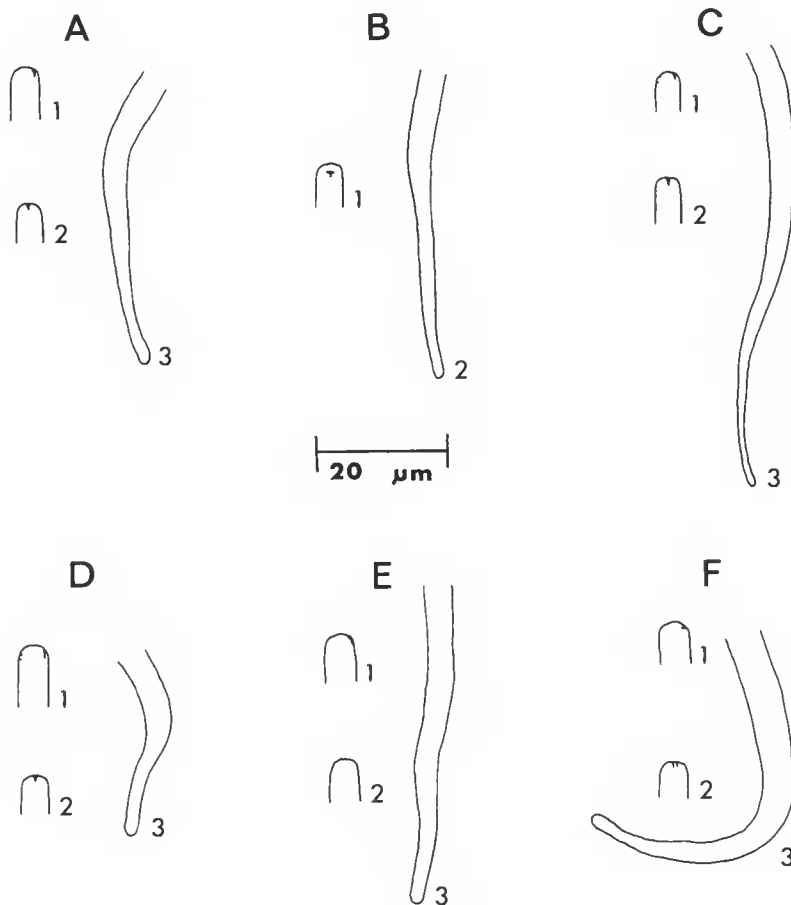


FIG. 17. — Microfilariae of various species of *Pelecitus* : A, *P. helacinus* (Molin, 1860), 1, 2, lateral and dorsal views of cephalic extremity, 3, tail ; B, *P. tercostatus* (Molin, 1860), 1, dorsal view of cephalic extremity ; 2, tail ; C, *P. anhingae* Vuylsteke, 1957, 1, 2, lateral and dorsal views of cephalic extremity, 3, tail ; D, *P. andersoni* n. sp., 1, 2, lateral and dorsal views of cephalic extremity, 3, tail ; E, *P. chabaudi* n. sp., 1, 2, lateral and dorsal views of cephalic extremity, 3, tail ; F, *P. vuylstekae* nom. nov., 1, 2, lateral and dorsal views of cephalic extremity, 3, tail.

COMMENTS

The name “*P. ardeae*” was preoccupied by MOLIN’s species and we propose *P. vuylsteke* nom. nov. for this material.

VUYLSTEKE (1957) did not designate a holotype or allotype and we consequently have chosen lectotype (male) and allolectotype (female) specimens from the syntypes.

BARUS *et al.* (1978) considered *P. ardeae* sensu VUYLSTEKE a synonym of *P. fulicaeae-trae*. The morphology of the two species is clearly different (see Key to species).

SPECIES INQUIRENDAE

1. *Pelecitus falconis* (Rudolphi, 1819)

Spiroptera falconis Rudolphi, 1819 : 28, 254-255.

Pelecitus falconis : YAMAGUTI, 1961 : 300. — In part BAYLIS, 1944 : 800. — LÓPEZ-NEYRA, 1956 : 98-100 ; 1957 : 201-204, 219. — DISSANAIKE, 1967 : 102. — SONIN, 1968 : 358-359. — DISSANAIKE and FERNANDO, 1974 : 201-203.

SPECIMENS : 1) Types : we were unable to locate them. 2) BM n° 1946.5.16.40-43 (catalogued as *P. ?falconis*), ex. *Pernis* sp. at Mysore State, India, specimens of BAYLIS.

LOCALITY : Type from Old World (locality not given, see Comments). Others from India.

HOSTS : From RUDOLPHI (1819), Falconidae : *Falco vespertinus* L. (= *Falconis rufipedis*, referred to as *Falco rufipes* by DIESING (1851)) (type). From BAYLIS (1944), Accipitridae : *Pernis* sp.

SITE IN HOST : Feet.

COMMENTS

RUDOLPHI (1819) briefly described *Spiroptera falconis* and listed it as a “*species dubia*”. He did not illustrate the species or state where the host was collected. However, *F. vespertinus* occurs in Europe, Asia, and Africa (HOWARD and MOORE, 1984).

BAYLIS (1944) tentatively identified as *P. falconis* specimens (n° 2 in “Specimens” above) in poor condition from *Pernis* sp. in India. His brief description is compatible with RUDOLPHI’s and we choose to definitively attach the name *P. falconis* to BAYLIS’s material. Among the species of *Pelecitus* from Falconiformes in the Old World, *P. falconis* differs from *P. armenica* and *P. chabaudi* by the possession of broad lateral alae, and from *P. polamaetus* by the absence of markedly protuberant cephalic papillae (BAYLIS, 1944 ; present study). The condition of BAYLIS’s specimens precludes, however, a detailed description of *P. falconis* and we leave it a *species inquirenda*.

DIESING (1851) described *P. serpentulus* from Falconiformes in Brazil and considered it conspecific with *P. falconis* (RUDOLPHI, 1819) although he used the specific name *serpentu-*

lus. BAYLIS (1944) pointed out that RUDOLPHI's name was senior. DIESING's (1857) illustration of the tail of the male does not match BAYLIS's description. Moreover, the synonymy was apparently based on host group whereas many species of *Pelecitus* in South America are not host specific.

SONIN (1968) suggested that *P. falconis* and *P. fulicaeatrae* are synonyms. However, see Comments under *P. fulicaeatrae* with regard to reports from Falconiformes.

2. *Pelecitus serpentulus* (Diesing, 1851)

Spiroptera serpentulus Diesing : In part DIESING, 1851 : 221 ; 1857 : 9-10, figs. 1-7 of pl. 2 ; 1861 : 677. — MOLIN, 1860 : 961-963. — DRASCHE, 1884 : 202, figs. 18-19 of pl. 13. — STOSSICH, 1897 : 86-87.

Pelecitus serpentulus : In part RAILLIET and HENRY, 1910 : 251. — YORKE and MAPLESTONE, 1926 : 412. — YAMAGUTI, 1961 : 300.

SPECIMENS : Types : we were unable to locate them.

LOCALITY : Type from Brazil (specific locality not given).

HOSTS : From DIESING (1851), Falconidae : *Daptorius americanus* (Boddaert) (= *Falco aquilinus*) (type), *Herpetotheres cachinnans* (L.) (= *Falco cachinnans*) ; Accipitridae : *Busarellus nigricollis* (Latham) (= *Falco milvoides*), *Geranospiza caerulescens* (Temminck) (= *Falco gracilis*), *Buteo magnirostris* (Gmelin) (= *Falco magnirostris*), *Buteogallus u. urubitinga* (Gmelin) (= *Falco urubitinga*), *Leucopternis melanops* (Latham) (= *Falco melanops*), *Parabuteo u. unicinctus* (Temminck) (= *Falco unicinctus*), *Asturina n. nitida* (Latham) (= *Falco nitidus*). — From MOLIN (1860), Accipitridae : *Harpia harpyja* (L.) (= *Falco destructor*) ; Picidae : *Dryocopus l. lineatus* (L.) (= *Picus lineatus*), *Phloeocastes robustus* (Lichtenstein) (= *Picus robustus*).

SITE IN HOST : Among tendons of feet.

COMMENTS

DIESING (1851) described *P. serpentulus* and although he considered it conspecific with *P. falconis* (RUDOLPHI, 1819) from Falconiformes in the Old World, he used the specific name *serpentulus*. See Comments under *P. falconis*.

DIESING (1857) and MOLIN (1860) added to DIESING's original description, MOLIN using material from Piciformes as well as Falconiformes in Brazil. DRASCHE (1884) redescribed DIESING's and MOLIN's material. *Pelecitus serpentulus* remains poorly described and BAYLIS (1944) suggested that the material DRASCHE examined included more than one species. There is little alternative but to regard *P. serpentulus* as a *species inquirenda*.

3. *Pelecitus quadripapillosus* (Molin, 1860)

Spiroptera quadripapillosa Molin, 1860 : 964. — DRASCHE, 1884 : 202. — STOSSICH, 1897 : 88.

Pelecitus quadripapillosus : RAILLIET and HENRY, 1910 : 251. — YORKE and MAPLESTONE, 1926 : 412. — SKRJABIN and SHIKHOBALOVA, 1948 : 403. — LÓPEZ-NEYRA, 1956 : 102 ; 1957 : 199, 213. — YAMAGUTI, 1961 : 300. — SONIN, 1968 : 366.

SPECIMENS : Types : we were unable to locate them.

LOCALITY : Type from Villa Maria, Brazil. Others from Argentina.

HOST : From MOLIN (1860), Threskiornithidae : *Ajaia ajaja* (L.) (= *Platalea ajaja* L.) (type).

SITE IN HOST : Among tendons of feet.

COMMENTS : Males have not been described and females only briefly (MOLIN, 1860) ; consequently we designate *P. quadripapillosus* as a *species inquirenda*.

4. *Pelecitus ardeae* (Molin, 1860) n. comb.

Spiroptera ardeae Molin, 1860 : 981-982. — DRASCHE, 1884 : 206-207, fig. 28 of pl. 11. — STOSSICH, 1897 : 98.

SPECIMENS : Types : we were unable to locate them..

LOCALITY : Type from Barra do Rio Jaure, Brazil.

HOST : From MOLIN (1860), Ardeidae : *Ardea cocoi* L.

SITE IN HOST : Feet.

COMMENTS : MOLIN (1860) designated his species a *species inquirenda* as males were not available and the females were poorly preserved.

SPECIES OF INCERTAE SEDIS

Pelecitus alatus Walton, 1927, does not belong in *Pelecitus*. Its proper generic position is unclear although the large cuticular elevations bordering the oral opening, unusually long oesophagus, and markedly unequal spicules (WALTON, 1927) suggest it belongs in Dicheilonematinae (Diplotrienoidea). We have been unable to locate the type specimens and regard *P. alatus* as a species of *incertae sedis*.

PELECITUS SPECIES IN MAMMALS

Two filarioid species of mammals which are or have until recently been placed in *Dirofilaria* appear to be derived from *Pelecitus* species in birds and we propose herein their

transfer to *Pelecitus*. *Pelecitus scapiceps* (Leidy, 1886) n. comb. [= *Dirofilaria scapiceps* (Leidy, 1886) Yorke and Maplestone, 1926 ; = *Loaina scapiceps* (Leidy, 1886) Eberhard and Orihel, 1984] generally occurs around the tendons in the ankle region of Leporidae in North America (BARTLETT, 1983, 1984b, 1984c) and *Pelecitus roemerii* (Linstow, 1905) n. comb. [= *Dirofilaria roemerii* (Linstow, 1905) Anderson, 1959] generally occurs near the insertion of the sartorius muscle in the knee region of Macropodidae in Australia (SPRATT, 1975). In addition to inhabiting sites in the definitive host similar to those inhabited by the species in birds, *Pelecitus scapiceps* and *Pelecitus roemerii* are easily accommodated in *Pelecitus* as morphologically defined. Both have a pre-oesophageal ring, lateral alae, post-deirids, short spicules, and a sheathed microfilaria, the posterior part of the body of which tapers towards a bluntly rounded extremity (ANDERSON, 1959 ; SPRATT, 1972 ; BARTLETT, 1983). This combination of characters is not found in other species of *Dirofilaria*. Both *P. scapiceps* and *P. roemerii* develop in the fat body of the intermediate host (HIGHBY, 1943 ; SPRATT, 1972 ; BARTLETT, 1984a), as does *P. ceylonensis* (see DISSANAIKE, 1967), the only species from birds for which development has been studied. Species of *Dirofilaria* with the exception of *D. corynodes*, develop in the Malpighian tubules (ADDISON, 1980 ; BARTLETT, 1984a).

Pelecitus scapiceps resembles those species from birds in which the body is regularly or irregularly twisted, the spicules are stout, the caudal papillae extending into the alae are not divided into two groups, and granular inclusions are commonly present in the caudal alae (*P. andersoni*, *P. helicius*, *P. tubercauda*). These species are known only from the New World and *P. scapiceps* may have been captured after lagomorphs first reached southern North America and parts of South America in the late Pleistocene (DAWSON, 1967, 1981). The capture probably occurred in the south because *P. scapiceps* is apparently better adapted to the southerly occurring *Sylvilagus floridanus* than the northerly occurring *Lepus americanus* and thus appears only recently to have moved northward (BARTLETT, 1984c). To consider *P. scapiceps* as derived from birds in this region also explains why it is restricted to the New World although suitable lagomorph definitive hosts and mosquito intermediate hosts are cosmopolitan (BARTLETT, 1983, 1984b).

BARTLETT (1983) suggested a close phylogenetic relationship between *P. scapiceps* and *Loaina uniformis* (Price, 1957) Eberhard and Orihel, 1984 (= *Dirofilaria uniformis* Price, 1957). *Loaina uniformis* inhabits the subcutaneous tissues of the shoulder and lumbar regions of lagomorphs and, like *P. scapiceps*, is restricted to the New World (BARTLETT, 1983). *Loaina uniformis* may have evolved through paedomorphosis from *P. scapiceps* (see BARTLETT, 1983, 1984b). However, adult *L. uniformis* lack lateral alae and post-deirids (BARTLETT, 1983), thus warranting the generic separation of the species from *Pelecitus*. Moreover, the site occupied by adult *L. uniformis* is different than that typically occupied by species of *Pelecitus*.

BOTERO *et al.* (1984) reported a mature male of "an undescribed species of *Loaina*" resembling "*L. scapiceps*" from the eye of a human in Columbia. This zoonotic species, which we consider to be a species of *Pelecitus*, may have had an avian rather than mammalian reservoir. *Pelecitus* is richly represented in the South American avian fauna, whereas *P. scapiceps* is currently unreported from South America.

Pelecitus roemerii resembles that group of species from birds in which the left spicule has a delicate lamina and the caudal papillae extending into the alae can be divided into

large pre-anals and smaller ad- to post-anals (*P. anhingae*, *P. fulicaeatrae*, *P. polamaetus*, *P. tercostatus*, *P. vuylstekae*). Like *P. tercostatus*, the body of *P. roemeri* is not coiled or twisted. To consider *P. roemeri* as recently derived from species in birds explains its curious presence in the highly evolved Macropodidae of Australia. This is in contrast to the absence of other species of *Dirofilariinae* in the Australian mammalian fauna (SPRATT and VARUGHESE, 1975) and the absence of *P. roemeri* in marsupials on other continents. Species of *Pelecitus* are currently unknown in Australian birds but the Australian avian filarioid fauna is poorly known. Species of *Pelecitus* do occur in birds in Southeast Asia.

The vectors of *P. roemeri* are tabanids (SPRATT, 1972) whereas those of *P. scapiceps* and at least one of the species in birds are mosquitoes (HIGHBY, 1943 ; DISSANAIKE, 1967 ; BARTLETT, 1984a). The difference may not be significant, however. *Dirofilaria ursi* is transmitted by simuliids whereas the other species of *Dirofilaria* in which development has been studied are transmitted by mosquitoes (ADDISON, 1980). Similarly, *Mansonella ozzardi* generally develops in ceratopogonids, as do other species in the genus, but in certain regions it also develops in simuliids (TIDWELL and TIDWELL, 1982).

CONCLUDING COMMENTS

The placement of *P. scapiceps* and *P. roemeri* in *Pelecitus* marks the first time in the modern classification of the Filarioidea that species from mammals and birds have been placed in the same genus. The above suggests that morphology may be more important in the systematics of the Filarioidea than host group, especially in view of the "capture" phenomenon. Further study may reveal other examples where filarioids from birds have transferred to mammals. For example, *Rumenfilaria andersoni* of moose (*Alces alces*) (see LANKESTER and SNIDER, 1982) has all the morphologic characters of the avian filarioid genus *Chandlerella*.

Some species of *Pelecitus* (e.g. *P. helycinus*, *P. fulicaeatrae*) have been reported from a diversity of bird families and orders (table 3) and DISSANAIKE (1967) provided experimental evidence of the lack of host specificity of *P. ceylonensis*. Other species of *Pelecitus* have been reported from only one bird family but this may simply reflect our incomplete knowledge of their distribution as most species have not been rediscovered since they were described. Broad host distributions are not unusual amongst avian filarioids and numerous other examples exist (BARTLETT *et al.*, 1985). Thus, an extensive host list need not be attributed to a species complex (*cf.* SONIN, 1968).

Species with broad host distributions may occur within bird communities, as suggested by BARTLETT and ANDERSON (1980). For example, *P. fulicaeatrae* appears to be predominantly a parasite of birds in aquatic environments and *P. helycinus* a parasite of birds in tropical forests. The lack of host specificity of species occurring in host communities may facilitate transfer to new host groups. Thus, the "capture" of a bird filarioid by a mammal may not be that extraordinary.

The genus *Pelecitus* is cosmopolitan (table 4). Some species in birds, however, appear to be more geographically restricted than others. For example, the closely related species

P. helycinus, *P. andersoni*, and *P. tubercauda* are known only from the New World and *P. anhingae*, *P. polamaetus*, and *P. vuylstekae* only from Africa. A more complete knowledge of the world avian filarioid fauna is required, however, to confirm or refute this. Other species, such as *P. fulicaeatrae*, apparently have broad geographic distributions, having been reported from both the Old and New Worlds. Further study may show that other species are similarly widely distributed.

KEY TO SPECIES

We propose the following key to the species of *Pelecitus* (note : *species inquirendae* are not included, nor is *P. armenica* for which insufficient information is available ; measurements given are from the present study unless otherwise indicated) :

- 1 (12). Caudal papillae extending into alae arranged in distinct pattern of large pre-anals and smaller ad- to post-anals ; spicules unequal, lamina of left delicate.
- 2 (5). Body of gravid female straight or curved ; lateral alae of female symmetrical.
- 3 (4). Body long (male 16-32 mm, female 95-173 mm) (from MACKERRAS, 1962). *P. roemeri*
- 4 (3). Body short (male 7-12 mm, female 8-30 mm) (from MOLIN, 1860 ; present study).
P. tercostatus
- 5 (2). Body of gravid female twisted or coiled ; lateral alae of female asymmetrical.
- 6 (11). Cephalic papillae markedly protuberant ; vulva accentrically positioned on cone of tissue ;
oesophagus of female long (900-1 400 μ m).
- 7 (8). Cuticle appearing transversely ridged as well as striated ; left ala of female broad (125 μ m).
P. polamaetus
- 8 (7). Cuticle striated but not ridged ; left ala of female narrow (35-60 μ m).
- 9 (10). Oesophagus of female distinctly divided *. *P. anhingae*
- 10 (9). Oesophagus of female indistinctly divided *. *P. vuylstekae*
- 11 (6). Cephalic papillae slightly or not salient ; vulva centrally positioned on cone of tissue ;
oesophagus of female short (380-640 μ m) (from VANDERBURGH *et al.*, 1984 ; present study).
P. fulicaeatrae
- 12 (1). Caudal papillae extending into alae extremely variable in size, number, and arrangement ;
spicules subequal or equal, lamina of left stout.
- 13 (14). Caudal alae of male narrow. *P. chabaudi*
- 14 (13). Caudal alae of male broad.
- 15 (18). Body of gravid female in form of tight helix.
- 16 (17). Vulva markedly protuberant ; oesophagus indistinctly divided. *P. tubercauda*
- 17 (16). Vulva slightly or not protuberant ; oesophagus distinctly divided. *P. helycinus*
- 18 (15). Body of gravid female in form of loose helix, spiral, circular coils, or irregularly twisted.
- 19 (20). Vulva generally posterior to oesophago-intestinal junction ; lateral alae narrow (see BART-
LETT, 1984b, 1984c). *P. scapiceps*
- 20 (19). Vulva generally anterior to oesophago-intestinal junction ; lateral alae broad (note : the
illustrations in DISSANAIKE, 1967, and in COY OTERO, 1982, suggest broad lateral alae).
- 21 (22). Oesophagus distinctly divided * ; granular inclusions commonly present within caudal alae.
P. andersoni
- 22 (21). Oesophagus indistinctly divided or not divided *, granular inclusions not reported within
caudal alae.

- 23 (24). Body of female long (15-20 mm) ** (from DISSANAIKE and FERNANDO, 1974 ; COY OTERO, 1982). *P. galli*
P. barusi
- 24 (23). Body of female short (6-12 mm) ** (from DISSANAIKE, 1967 ; present study).
- 25 (26). Body of gravid female in form of spiral.....*P. ceylonensis*
- 26 (25). Body of gravid female in form of circle..... *P. circularis*

* See comments under " Morphologic characters : 6 — Oesophagus ".

** See comments under " Morphologic characters : 12 — Morphometrics ".

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